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ABSTRACT

This manual is the first of three manuals for teaching repair skills to entry-level microcomputer service technicians. Although it focuses on basic computer repair skills, it also highlights the people skills needed by service providers. The manual contains 11 units. Each instructional unit includes some or all of these basic components: performance objectives, suggested activities for teachers and students, information sheets, assignment sheets, job sheets, visual aids, tests, and answers to the tests. Units are planned for more than one lesson or class period of instruction. (This teacher's edition contains materials suitable for reproduction and hand-outs to students.) The units cover the following topics: computer history highlights and career overview, microcomputer overview, safety, assembly and start-up procedures, operating systems, tools and equipment, peripherals, publications and resources, customer relations and recordkeeping, troubleshooting, and parts and supplies. (KC)

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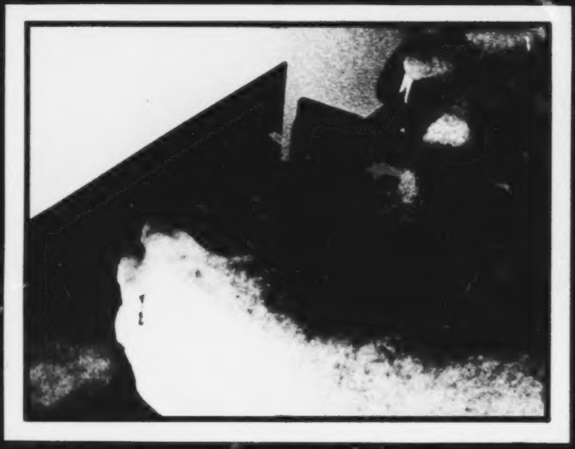

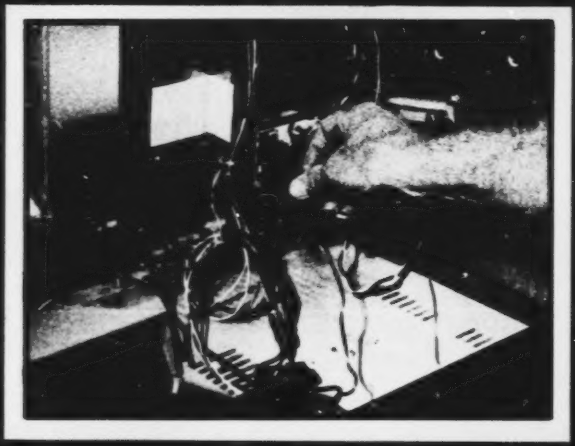

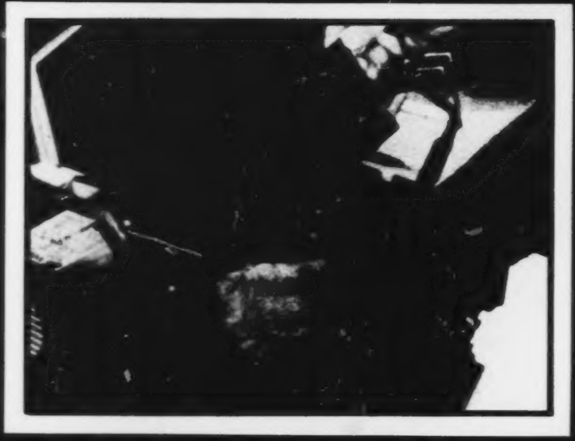

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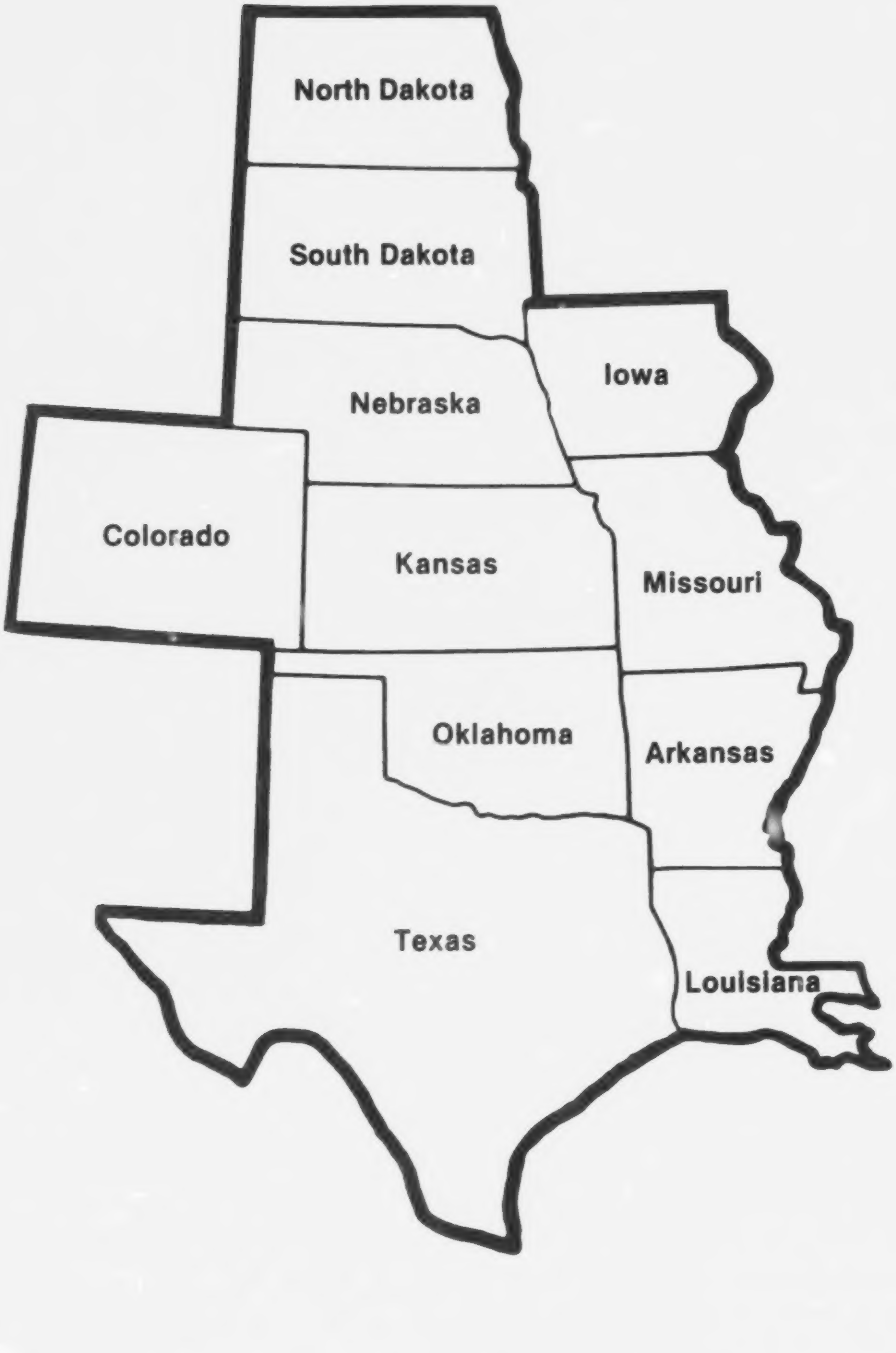
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BASIC MICROCOMPUTER SERVICE TECHNICIAN

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BASIC MICROCOMPUTER SERVICE TECHNICIAN

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FOREWORD

Some repair facilities estimate that close to 75% of the time spent repairing a microcomputer is spent in finding the problem. The committee that planned MAVCC's three-text microcomputer repair series had that statistic in mind as they outlined the books. In fact, the emphasis on "half splitting" and other forms of *systematic* troubleshooting serve to closely tie the three books together.

However, this first text, *Basic Microcomputer Service Technician* also stresses the people skills required by an entry-level technician. In fact, customers with computer problems are not the most pleasant people to talk to, so the people skills range into the realm of diplomacy. Getting the customer to accurately describe a problem is sometimes half the battle. And of course, the paperwork and record keeping have to be handled well in order to maintain everything from efficiency to inventory.

Electronics instructors who have been searching for curriculum with realistic content will welcome *Basic Microcomputer Service Technician.* Many of the committee members who helped plan the book are electronics instructors who articulated classroom needs for our curriculum. Dr. A. O. Brown III, the writer, has taught the *systematic* approach to microcomputer troubleshooting for years in his popular computer classes at Pittsburg State University, Pittsburg, Kansas. Industry members of the committee stressed the realistic needs for orderly record keeping and people skills. We think the blend of expertise that went into planning and writing the book is evident throughout the text, and that the effort will have some really positive results in electronic programs around the nation.

By the way, *Basic Microcomputer Service Technician* could serve some other people well too. Truth is, it may be one of the best computer literacy books around, so computer owners and even computer store owners will find worthwhile materials in the text. In that respect, it may be one of the most utilitarian books that MAVCC has ever published. We want it to serve classroom needs effectively, but if it does a little more than that, we don't mind at all.

James Dasher, Chairman
Board of Directors
Mid-America Vocational
Curriculum Consortium

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PREFACE

Basic Microcomputer Service Technician is the first of MAVCC's three-text microcomputer service and repair series. This first text is prerequisite to the other two texts, but the other books may be taught in any order to facilitate program needs.

Advanced Microcomputer Service Technician addresses training needs for "chip level" technicians, and *Microcomputer Peripheral Service Technician* covers repair procedures for floppy disk drives, printers, and monitors, and will be welcomed by basic students who want to grow or advanced students who want to specialize.

The Bureau of Labor Statistics predicts that the need for computer service technicians will be greater than the supply for years to come. What a great justification for expanding any electronics program! We feel that MAVCC's curriculum will give new and expanded programs the foundation they need to answer the high technology needs of American business and industry.

Greg Pierce
Executive Director
Mid-America Vocational
Curriculum Consortium

ACKNOWLEDGEMENTS

Appreciation is extended to the many individuals who contributed their time and expertise to the successful development of *Basic Microcomputer Service Technician*. The Resource Committee which planned and approved the text included outstanding electronics instructors from MAVCC member states, representatives from the microcomputer service industry, and even a computer store owner. A special thank you goes to the members of the Resource Committee:

Charles Black, Shreveport-Bossier Vo-Tech, Shreveport, Louisiana
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Gus Rummel, Central Texas College, Killeen, Texas
Ron Vorderstrasse, Central Community College, Columbus, Nebraska

Another special thank you goes to **Dr. A. O. Brown III** of Pittsburg, Kansas, for a splendid job of writing the text and also for his contributions as a member of the Resource Committee.

Appreciation is also extended to Dan Fulkerson, MAVCC's Publications Coordinator, for his contributions as editor of the project, and to Mary Kellum and Jane Huston of MAVCC for editing assistance.

A special appreciation goes out to Damon Davis and to the publishers Howard W. Sams & Co., Inc., for their active support of the project and for materials contributed to the project.

A concluding thank you goes to many people in the industry who took time to talk to the writer and editorial staff on the phone, and to assist with other technical matters in correspondence. Engineers, Service Managers, and Customer Service personnel from many companies are among the list that is too numerous to include here, but a collective thank you goes to all of them.

The text was phototypeset in the Oklahoma State Vo-Tech Communications Center, and for her dedicated contribution, appreciation is extended to the phototypesetter Leslie Mathis.

Another vote of thanks goes to the personnel of the Oklahoma State Vo-Tech Print Shop for their excellent work in printing the text.

USE OF THIS PUBLICATION

Instructional Units

Basic Microcomputer Service Technician includes eleven units. Each instructional unit includes some or all of the basic components of a unit of instruction; performance objectives, suggested activities for teachers and students, information sheets, assignment sheets, job sheets, visual aids, tests, and answers to the tests. Units are planned for more than one lesson or class period of instruction.

Careful study of each instructional unit by the teacher will help to determine:

A. The amount of material that can be covered in each class period
B. The skills which must be demonstrated

    1. Supplies needed
    2. Equipment needed
    3. Amount of practice needed
    4. Amount of class time needed for demonstrations

C. Supplementary materials such as pamphlets or filmstrips that must be ordered
D. Resource people who must be contacted

Objectives

Each unit of instruction is based on performance objectives. These objectives state the goals of the course, thus providing a sense of direction and accomplishment for the student.

Performance objectives are stated in two forms: unit objectives, stating the subject matter to be covered in a unit of instruction; and specific objectives, stating the student performance necessary to reach the unit objective.

Since the objectives of the unit provide direction for the teaching-learning process, it is important for the teacher and students to have a common understanding of the intent of the objectives. A limited number of performance terms have been used in the objectives for this curriculum to assist in promoting the effectiveness of the communication among all individuals using the materials.

Reading of the objectives by the student should be followed by a class discussion to answer any questions concerning performance requirements for each instructional unit.

Teachers should feel free to add objectives which will fit the material to the needs of the students and community. When teachers add objectives, they should remember to supply the needed information, assignment and/or job sheets, and criterion tests.

Suggested Activities for the Instructor

Each unit of instruction has a suggested activities sheet outlining steps to follow in accomplishing specific objectives. Duties of instructors will vary according to the particular unit; however, for best use of the material they should include the following: provide students with objective sheet, information sheet, assignment sheets, and job sheets; preview filmstrips, make transparencies, and arrange for resource materials and people; discuss unit and specific objectives and information sheet; give test. Teachers are encouraged to use any additional instructional activities and teaching methods to aid students in accomplishing the objectives.

Information Sheets

Information sheets provide content essential for meeting the cognitive (knowledge) objectives in the unit. The teacher will find that the information sheets serve as an excellent guide for presenting the background knowledge necessary to develop the skill specified in the unit objective.

Students should read the information sheets before the information is discussed in class. Students may take additional notes on the information sheets.

Transparency Masters

Transparency masters provide information in a special way. The students may see as well as hear the material being presented, thus reinforcing the learning process. Transparencies may present new information or they may reinforce information presented in the information sheets. They are particularly effective when identification is necessary.

Transparencies should be made and placed in the notebook where they will be immediately available for use. Transparencies direct the class's attention to the topic of discussion. They should be left on the screen only when topics shown are under discussion.

Assignment Sheets

Assignment sheets give direction to study and furnish practice for paper and pencil activities to develop the knowledge which is a necessary prerequisite to skill development. These may be given to the student for completion in class or used for homework assignments. Answer sheets are provided which may be used by the student and/or teacher for checking student progress.

Job Sheets

Job sheets are an important segment of each unit. The instructor should be able to demonstrate the skills outlined in the job sheets. Procedures outlined in the job sheets give direction to the skill being taught and allow both student and teacher to check student progress toward the accomplishment of the skill. Job sheets provide a ready outline for students to follow if they have missed a demonstration. Job sheets also furnish potential employers with a picture of the skills being taught and the performances which might reasonably be expected from a person who has had this training.

Test and Evaluation

Paper-pencil and performance tests have been constructed to measure student achievement of each objective listed in the unit of instruction. Individual test items may be pulled out and used as a short test to determine student achievement of a particular objective. This kind of testing may be used as a daily quiz and will help the teacher spot difficulties being encountered by students in their efforts to accomplish the unit objective. Test items for objectives added by the teacher should be constructed and added to the test.

Test Answers

Test answers are provided for each unit. These may be used by the teacher and/or student for checking student achievement of the objectives.

BASIC MICROCOMPUTER SERVICE TECHNICIAN

INSTRUCTIONAL/TASK ANALYSIS

UNIT I: COMPUTER HISTORY HIGHLIGHTS AND CAREER OVERVIEW

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What the Worker Should Know (Cognitive)
	1. Terms and definitions
	2. Important persons and their contributions to early computer history
	3. Milestones in American computer history and their dates
	4. Milestones in microcomputer history
	5. Highlights in the history of microcomputer chips
	6. Other significant elements in microcomputer history
	7. Job outlook for computer repair technicians
	8. Job classifications
	9. Educational recommendations for computer repair technicians
	10. What to expect in the workplace
	11. Desired physical requirements for computer repair technicians
	12. Qualities that lead to advancement
	13. Where and how repair technicians work
	14. Pay scales
	15. Related jobs and their skill requirements
	16. The ACID test for successful computer repair technicians
17. Use the ACID test to rate your personal potential as a computer repair technician	

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What the Worker Should Know (Cognitive)

UNIT II: MICROCOMPUTER OVERVIEW

1. Terms and definitions
2. Computer-related abbreviations and their meanings
3. Basic microcomputer components and their functions
4. CPU sections and their functions
5. Types of busses
6. Other characteristics of busses
7. Memory devices and their definitions
8. Clock and timing characteristics
9. Steps in a microcomputer operating cycle
10. Components of a chip family
11. Chip pinouts
12. Steps in reading a pinout
13. Abbreviations and other conventions for labeling pinouts
14. Steps in typical chip family evolution
15. General I/O chips
16. Specialized I/O chips
17. Directions in chip family evolution
18. Functions of an operating system program
19. Types of operating systems
20. Characteristics of disk operating systems
21. Typical disk operating systems and their uses

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What the Worker Should Know (Cognitive)
	22. Identification of disk operating systems
	23. Importance of DOS identification in troubleshooting
	24. Types of printers and their characteristics
	25. Types of disk drives
	26. Modems and their characteristics
	27. Video displays and their characteristics
	28. Specialized peripherals
	29. Levels of language and their orders
	30. Characteristics of machine language
	31. Characteristics of assembler language
	32. Characteristics of traditional high level language
	33. Characteristics of applications languages
	34. Characteristics of applications software
	35. Numbering systems and their structures
36. Convert binary numbers to decimal numbers and decimal numbers to binary numbers	
37. Convert octal numbers to binary and decimal numbers and binary and decimal numbers to octal numbers	
38. Convert hexadecimal numbers to binary and decimal numbers and binary and decimal number to hexadecimal numbers	
39. Convert decimal numbers into binary, hexadecimal, and binary coded decimal numbers	
40. Label a pinout for a microprocessor	

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)

RELATED INFORMATION: What the Worker Should Know (Cognitive)

UNIT III: SAFETY

1. Terms and definitions
2. General safety
3. Basic electrical safety
4. Steps in safely taking a high voltage reading
5. Ways to control static electricity
6. Guidelines for protecting media from magnetic damage
7. Guidelines for handling floppy disks
8. Guidelines for storing floppy disks
9. Environmental safety
10. Other equipment-related safety guidelines
11. Items related to personal safety
12. Complete a student safety pledge
13. Locate first aid and emergency areas
14. Discharge high voltage from a CRT

UNIT IV: ASSEMBLY AND START UP PROCEDURES

1. Terms and definitions
2. Steps in unpacking a microcomputer
3. Components required for system hookup

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What the Worker Should Know (Cognitive)
	4. Guidelines for internal system hookup
	5. Guidelines for completing system hookup
	6. Guidelines for hooking up disk drives
	7. Guidelines for hooking up printers and modems
	8. Microcomputer keyboards
	9. Important keys and their functions
	10. Power on/off and initialization routines
	11. Operating manuals
	12. Ways proper setup procedures help eliminate future problems
13. Hook up a microcomputer system	
14. Operate a microcomputer system to observe interaction of system components	

UNIT V: OPERATING SYSTEMS

	1. Terms and definitions
	2. Operating systems
	3. Typical functions of disk-based operating systems
	4. Typical functions of ROM-based operating systems
	5. Operating systems/hardware relationships
	6. Procedures for loading operating systems
	7. Relationships of logical/physical devices

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What the Worker Should Know (Cognitive)
	8. Basic Input/Output Systems and CP/M
	9. Guidelines for making a backup disk
	10. Parts of a disk and their functions
11. Backup a disk on an Apple computer	
12. Backup a disk on a TRS-80 computer	
13. Backup a disk on an IBM Personal Computer	

UNIT VI: TOOLS AND EQUIPMENT

	1. Terms and definitions
	2. Requirements for a healthy computer environment
	3. Line protection
	4. Static control
	5. Disk head cleaning kits and their uses
	6. Hand tools and their uses
	7. Test equipment most commonly used
	8. How logic probes work
	9. How VOM's and DVOM's work
	10. Safety precautions for making voltage measurements
	11. How a breakout box works
	12. Vendor support
	13. Other test equipment and its uses
14. Check power supply voltages with a DVOM	
15. Check system fuses with a DVOM	

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What the Worker Should Know (Cognitive)

UNIT VII: PERIPHERALS

1. Terms and definitions
2. Modes for printer interfacing
3. ASCII codes and their meanings
4. Dot matrix printer operations
5. Ink jet printer operations
6. Laser printer operations
7. Letter quality printer operations
8. Common electrical levels for sending serial information
9. BAUD rates and printer switch setup
10. BAUD rates
11. Printer handshaking protocol
12. Cable configurations for information transmission
13. Modems and how they work
14. Characteristics of floppy disk drives
15. Media for floppy disk drives
16. Hard disk drives
17. Classifications of computer terminals
18. Microcomputer cassette recorders
19. Memory expansion with RAM cards
20. Special cards and their uses
21. How networks operate
22. Hardware and software requirements for networking
23. Graphics devices and their characteristics
24. Characteristics of CRT-based video displays

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What the Worker Should Know (Cognitive)
	25. Other types of video displays
	26. Switch boxes and their uses
27. Diagram the interface between a microcomputer and a parallel printer	
28. Diagram the interface between a microcomputer and a serial printer	
29. Replace the ribbon and print head on a dot-matrix printer	
30. Hook up disk drives to an Apple microcomputer	

UNIT VIII: PUBLICATIONS AND RESOURCES

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What the Worker Should Know (Cognitive)
	1. Terms and definitions
	2. Equipment manuals and their characteristics
	3. Schematics and troubleshooting guides
	4. Warranties
	5. Block diagrams and wiring diagrams
	6. Trade journals
	7. User groups
	8. Support groups
9. Select resources to help solve microcomputer problems	
10. Conduct a survey of a local user's group	

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What the Worker Should Know (Cognitive)
UNIT IX: CUSTOMER RELATIONS AND RECORD KEEPING	
	1. Terms and definitions
	2. Guidelines for personal appearance
	3. BE attitudes for successful technicians
	4. General guidelines for conducting a customer conference
	5. Specific information to look for in a customer conference
	6. Matters to clarify before repairs begin
	7. Requirements for record keeping
	8. Procedure for returning equipment
	9. Troubleshooting and repair logs
	10. Persons who use records and the ways they use them
	11. Other skills that promote advancement
	12. Select true statements concerning service contracts
	13. Obvious candidates for service contracts
	14. Obvious candidates for system upgrades
	15. Guidelines for service calls
16. Conduct a customer conference	
17. Fill out a service order	
18. Advise a customer concerning repair costs	

JOB TRAINING: What the
Worker Should Be Able to Do
(Psychomotor)

RELATED INFORMATION: What
the Worker Should Know
(Cognitive)

UNIT X: TROUBLESHOOTING

1. Terms and definitions
2. General guidelines for troubleshooting
3. Basic techniques for troubleshooting
4. Typical forward to back troubleshooting routine
5. Sensory troubleshooting
6. Steps in the first routine after sensory troubleshooting
7. Troubleshooting when the operating system will boot up
8. Troubleshooting when the operating system will not boot up
9. Intermittent problems
10. Intermittent and other problems related to overheating
11. Record keeping for module replacement
12. Ways to determine if a module should be replaced
13. Unloading the system
14. Hardware vs. software problems
15. Ways to handle media problems
16. Keyboard problems and lockouts
17. Troubleshooting monitor problems
18. Steps in correcting monitor problems
19. Monitors with screen RAM problems
20. Disk drive characteristics and problems

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)

33. Check voltage on a microcomputer power supply
34. Troubleshoot a microcomputer that will not boot up
35. Check and replace faulty modules in a microcomputer system
36. Troubleshoot a malfunctioning floppy disk drive
37. Troubleshoot a malfunctioning microcomputer keyboard
38. Troubleshoot a malfunctioning microcomputer monitor
39. Troubleshoot a malfunctioning printer
40. Discharge high voltage from a CRT

RELATED INFORMATION: What the Worker Should Know (Cognitive)

21. Troubleshooting disk drive motors
22. Steps in removing disk drives
23. Steps in cleaning and lubricating disk drives
24. Troubleshooting disk drive speed problems
25. Steps in adjusting disk drive speed
26. Troubleshooting disk drive controller problems
27. Printer problems
28. Basic printer troubleshooting routine
29. Common printer mechanical problems and their solutions
30. Steps in troubleshooting a computer that will not drive a good printer
31. Other areas of software/printer problems
32. Printer handshakes

UNIT XI: PARTS AND SUPPLIES

JOB TRAINING: What the Worker Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What the Worker Should Know (Cognitive)
	1. Terms and definitions
	2. How to identify chips
	3. How to identify speed on memory chips
	4. Guidelines for inserting chips
	5. Parts listings and parts manuals
	6. Cross referencing
	7. Guidelines for handling and shipping static-sensitive parts
	8. Guidelines for handling and shipping floppy disk drives and printers
	9. Special considerations for handling hard disk drives
	10. Importance of quality parts and supplies
	11. Important points in parts record keeping
12. Solve problems concerning replacement parts	
13. Order parts from a parts catalog	
14. Roll in and seat a dual in-line IC	

BASIC MICROCOMPUTER SERVICE TECHNICIAN

Tools, Equipment, and Materials List

Standard screwdriver set
Phillips screwdriver set
Nutdriver set
Needlenose pliers (insulated handles)
Slip-joint pliers (insulated handles)
IC extractor
IC inserter
Soldering iron (low-voltage type not to exceed 40 watts)
Solder (electronic grade)
Logic probe
Breakout box
Volt-ohm milliamp meter (multimeter)
Digital volt-ohm milliamp meter (digital multimeter)
Alligator clips and leads
Selected microcomputer(s)
Selected printer(s)
Selected floppy disk drive(s)
Selected CRT-based video monitor(s)
Owner's manuals for selected equipment
Service manuals for selected equipment
Schematics or Computerfacts™ as available
Assortment of IC's for demonstration purposes
Available disk-based operating systems for demonstration purposes
Available ROM-based operating systems for demonstration purposes
System troubleshooting software for selected microcomputer(s)
Troubleshooting software for selected disk drive(s) (diagnostics)
Static mat and wrist clip (or equivalent)
Supply of floppy disks for backing up programs
Surge protectors
Anti-static spray
Small brushes
Compressed cleaning air
Dot-matrix and letter-quality printer ribbons
Dot-matrix print head (as required)

ALPHABETICAL LIST OF REFERENCES USED IN DEVELOPING THIS TEXT

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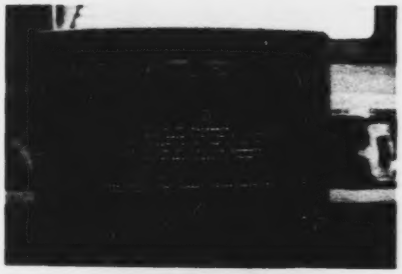

COMPUTER HISTORY HIGHLIGHTS AND CAREER OVERVIEW
UNIT I

UNIT OBJECTIVE

After completion of this unit, the student should be able to discuss historical highlights in computer development and list the names of important people in computer history. The student should also be able to list job opportunities for computer repair technicians, discuss attitudes and skills that lead to advancement, and complete a personal survey to test one's potential for success in the computer repair industry. These competencies will be evidenced by correctly performing the procedures outlined in the assignment sheet and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to computer history highlights and career overview with their correct definitions.
2. Match important persons with their contributions to early computer history.
3. Match milestones in American computer history with their dates.
4. Complete statements concerning milestones in microcomputer history.
5. Select true statements concerning highlights in the history of microprocessor chips.
6. Complete statements concerning other significant elements in microcomputer history.
7. Complete statements concerning the job outlook for computer repair technicians.
8. Differentiate between job classifications.
9. Select true statements concerning educational recommendations for computer repair technicians.
10. Complete statements concerning what to expect in the workplace.
11. Complete a list of desired physical requirements for computer repair technicians.
12. Complete statements concerning qualities that lead to advancement.

OBJECTIVE SHEET

13. Select true statements concerning where and how repair technicians work.
14. Complete a chart of pay scales.
15. Match related jobs with their skill requirements.
16. Complete statements concerning the ACID test for successful computer repair technicians.
17. Use the ACID test to rate your personal potential as a computer repair technician. (Assignment Sheet #1)

COMPUTER HISTORY HIGHLIGHTS AND CAREER OVERVIEW
UNIT I

SUGGESTED ACTIVITIES

A. Provide student with objective sheets.

B. Provide student with information and assignment sheets.

C. Discuss unit and specific objectives.

D. Discuss information sheet.

E. Invite a local business that uses computers in its operations to send a representative to talk to the class about computers in practical applications, problems with downtime, and how rapid changes in computer technology have affected business attitudes about computers.

F. Invite a local or area computer store owner to talk to the class about computer repair services and what it takes to be a good computer repair technician.

G. Invite a local or area computer repair technician to talk to the class about training, getting started in the business, and the chances for advancement.

H. Have your students survey the school for the number and types of computers being used. Have them talk with the person or people in charge of the school's computers and prepare a report on the types of problems the school has with the computers, with disk drives, and with printers. Have students pay special attention to the length of time repairs take and the inconvenience school departments may suffer from downtime.

I. Invite a local math teacher to talk to the class about the abacus as an early computing system, and have the teacher demonstrate the use of the abacus to class members.

J. Give test.

CONTENTS OF THIS UNIT

A. Objective sheet

B. Information sheet

C. Transparency Master 1 — Major Types of Computers

D. Assignment Sheet #1 — Use the Acid Test to Rate Your Personal Potential as a Computer Repair Technician

CONTENTS OF THIS UNIT

E. Answers to assignment sheet

F. Test

G. Answers to test

REFERENCES USED IN DEVELOPING THIS UNIT

A. *Occupational Outlook Quarterly.* Washington, DC 20212: U.S. Department of Labor, Bureau of Labor Statistics, Spring 1984.

B. *Occupational Outlook Handbook.* Washington, DC 20212: U.S. Department of Labor, Bureau of Labor Statistics, April 1982.

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COMPUTER HISTORY HIGHLIGHTS AND CAREER OVERVIEW
UNIT I

INFORMATION SHEET

I. **Terms and definitions**

A. Board — A shortened reference to a printed circuit board or the insulated surface on which circuit components are mounted and soldered in place

B. Chip — A complete electronic circuit which may contain miniature resisters, transistors, diodes, and related circuitry all integrated into a miniature silicon base and mounted in a common housing

C. Computer — An electronic device designed to make rapid, accurate computations from data programmed into it

D. Microprocessor — The arithmetic logic unit, registers, and timing and decoding circuitry usually contained in a single integrated circuit that controls computer activities

E. Main-frame computers — The largest and most expensive computers designed specifically to serve business, industry, and government in applications that require mass storage and fast retrieval (Transparency 1)

Example: Banks, airlines, and the Internal Revenue Service use main-frame computers

F. Minicomputers — Medium-sized and medium-priced computers that rival the storage capacity and operating speed of smaller main-frames, and are used in business, industry, and government where they perform mostly dedicated or single-task activities (Transparency 1)

Example: Food processors, laboratories, and hospitals use minicomputers

G. Microcomputers — The smallest and least expensive computers, designed for desk-top or portable use by an individual at home, yet versatile enough for applications in business, industry, and government (Transparency 1)

Example: Microcomputers enjoyed early popularity in the home for both education and playing electronic games, but as microcomputers expand in powers such as multi-tasking and multi-user applications, their use in business and industry will increase

H. Peripheral — Any device such as a disk drive, printer, modem, or video display added to a microcomputer to provide increased capacity for handling, storing, or presenting data

INFORMATION SHEET

I. Prototype — The first of its kind, the original from which later models are patterned

II. **Important persons and their contributions to early computer history**

A. Galileo (Galilei Galileo, 1564-1642) — An Italian astronomer, mathematician, and physicist who is credited with the invention of the telescope which he used to prove that the planets rotate around the sun

(NOTE: Historians credit Galileo with bringing mathematics and experimentation together, and some credit his genius as the base for all modern science and technology.)

B. Pascal (Blaise Pascal, 1623-1662) — A French mathematician and physicist who in 1642 invented a mechanical calculator that performed addition and subtraction

C. Boole (George Boole, 1815-1864) — A self-taught English mathematician whose works with symbolic language proved that logic could be reduced to a simple algebraic system where all variables have the value of either zero or one

(NOTE: Boole's theories are referred to as "Boolean Algebra" which is the heart of the binary number system in most digital computers.)

D. Babbage (Charles Babbage, 1792-1871) — An English mathematician who invented a "difference engine" and an "analytic engine" which are considered the true prototypes of modern computers

(NOTE: Babbage's engines never really functioned because his vision of a machine that could take in information, store information, perform mathematical calculations, and then print out the information was far ahead of what the technology of his day could manage.)

E. Jacquard (Joseph Jacquard, 1752-1834) — A French inventor who designed a loom to weave pre-designed patterns with the use of punch cards

(NOTE: The punch cards for Jacquard's loom were designed so that only one of two things could happen. If the punch card had a hole, a hook would emerge to place a certain thread in the pattern, and if the punch card did not have a hole, the thread was not engaged, and this is related to Boolean algebra, digital logic, and was similar in intent to modern punch cards used in some data processing.)

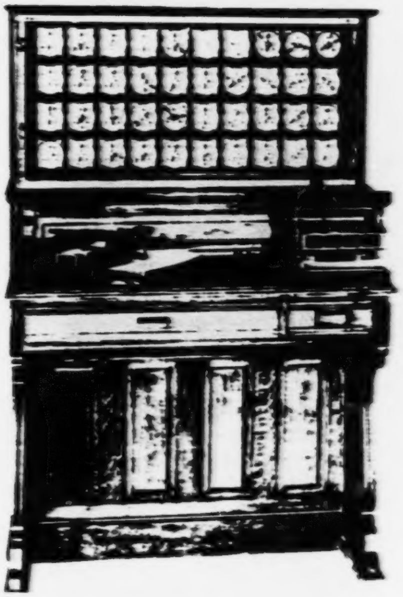
INFORMATION SHEET

III. **Milestones in American computer history and their dates**

A. 1890 — Herman Hollerith invented a punch card system using electromechanical relays, and the device was used in tabulating the 1890 U.S. census

(NOTE: In 1911, Hollerith formed the Tabulating Machine Company which in 1924 became the International Business Machines Corporation, or IBM as it is better known today.)

FIGURE 1



Courtesy John Wiley and Sons, Inc.

B. 1927 — Claude Shannon of Bell Telephone Laboratories developed switching systems that used practical applications of Boolean algebra, and similar devices are still used in the Bell system and computers

C. 1944 — Howard Aiken and his staff at Harvard University completed the Mark I, the first totally automated computer, and one which worked with electromechanical relays

D. 1944 — Whirlwind I, a computer commissioned by the U.S. Navy to help solve problems in aircraft design, was completed, and is typical of much of the early American computer development that may never have happened without the commitment and funding of the U.S. military services

(NOTE: The Whirlwind project is noteworthy because the inventors recognized the difficulty of working in machine language and actually wrote a separate program language for students to use when working with Whirlwind, and this idea evolved into the modern programming languages such as COBOL, FORTRAN, and BASIC which are used with modern computers.)

INFORMATION SHEET

E. 1946 — Following several years of development, the ENIAC (Electrical Numerical Integrator and Computer) was put into operation by the U.S. Army, and is noteworthy because it handled information in the parallel mode

(NOTE: The ENIAC was a massive array of vacuum tubes that required an entire building to house it, and it was used until 1955 when it was moved to the Smithsonian Institute where it is still on display.)

F. 1949 — Bell Telephone Laboratories invented the transistor, a device which revolutionized electronics in general and led to the solid-state circuitry in modern computers

G. 1952 — The first commercial computer was sold to the General Electric Company

H. 1952 — Following many years of development, the EDVAC (Electronic Discrete Variable Computer) was put into operation by the U.S. Army, and is noteworthy because it handled information in the serial mode and contained other programming concepts by John von Neumann, a scientist sometimes referred to as the Father of the modern computer

I. 1961 — The monolithic integrated circuit was invented, an event which gave computer design and computer circuitry a whole new direction totally different from anything that preceded it

IV. **Milestones in microcomputer history**

A. The Altair 8800 which was introduced in 1975 by MITS is generally considered the first microcomputer and is credited with sparking the interest that started the microcomputer revolution

(NOTE: The Altair 8800 actually had no keyboard and no monitor and had to be programmed with switches, but it intrigued computer hobbyists, had great add-on potential, and popularized the S-100 open-type bus system.)

B. Starting in 1977, three other major names first introduced microcomputers that all became popular:

1. Tandy Radio Shack introduced the TRS-80
2. Apple Computers introduced the Apple
3. Commodore Business Machines introduced the Pet

C. In 1981, IBM first marketed its PC, a system that quickly set new standards in the industry and inspired over a dozen clones designed to work like the PC and run the many new items of software designed specifically for the IBM system

INFORMATION SHEET

V. **Highlights in the history of microprocessor chips**

A. A company known as VIATRON made the earliest attempt to build microcontroller chips in the late 1960's

B. In 1970, INTEL introduced its 4004 and 8008 microprocessor chips

(NOTE: These microprocessor devices required a relatively large number of support chips.)

C. In 1971, INTEL designed and produced the 8080 chip which was quickly adopted for general computer use

(NOTE: The 8080 became very popular, is still very much in use, and the speed with which things in the computer world change is well indicated by the fact that the 8080 chip cost about $360 when it was first produced, and is available now for about $3.)

D. In 1971, Motorola produced its 6800 microprocessor

E. In 1972, MOS Technology produced its 6500 microprocessor

F. In 1975, Zilog introduced the Z-80 microprocessor

(NOTE: Other companies such as National and Fairchild produce microprocessor chips, but Apple, Tandy Corporation, and Commodore popularized the 8080, the 6800, the 6502, and the Z-80, and these chips have emerged as favorites.)

G. Major microprocessor chips have grown into chip families that have moved from the basic CPU chip to chips which are complete microcomputers with CPU, memory, and I/O functions integrated on one silicon chip

VI. **Other significant elements in microcomputer history**

A. The development of software to support microcomputers has had a powerful impact on the microcomputer industry

1. Specialized software for business has helped make the microcomputer an almost necessary piece of office equipment

2. Specialized software for games, education, and home management have increased computer sales in homes and schools

B. The expanded use of programming languages such as BASIC, dedicated to programming discreet information, opened the world of programming to almost anyone who wanted to have a go at it

(NOTE: Programming for a microcomputer does require certain talents, but programming for analog devices frequently requires a person with advanced mathematics skills, and many programs for the early analog computers required teams of mathematicians and scientists to write effective programs.)

INFORMATION SHEET

VII. **Job outlook for computer repair technicians**

A. Employment opportunities for computer repair technicians is expected to grow much faster than the average for all occupations through the 1980's

(NOTE: Forecasts from the Bureau of Labor Statistics indicate that by 1995, the employment of computer repair technicians will increase by 97% over its 1982 level.)

B. The demand for computer repair technicians will be close to 50% higher than the supply of computer repair technicians throughout the 1980's

C. Downturns in the national economy will not affect computer repair technicians as it does other areas of employment such as construction jobs

D. Of the five occupations projected for the highest growth rate between now and 1995, computer service technician is at the top of the list

VIII. **Job classifications**

A. Board level technician — Usually works with some supervision in performing maintenance on microcomputers and peripherals and in completing troubleshooting routines to a point that malfunctioning boards or components can be identified, replaced, and sent to a repair center

(NOTE: In short, the board level technician is known as a "board swapper.")

B. Chip level technician — Usually works unsupervised, is capable of all board level activities, but also troubleshoots more complex internal problems and identifies, removes, and replaces chips and other malfunctioning parts on printed circuit boards

(NOTE: In other words, the malfunctioning boards shipped for repair are sent to centers where chip level technicians repair them.)

IX. **Educational recommendations for computer repair technicians**

A. Most employers require applicants to have a minimum of one year of training in basic electronics or electrical engineering, but few employers require an applicant to have a formal degree in electronics

B. Students planning to work as computer repair technicians should have a good background in math and a basic understanding of physics

C. Computer repair technicians should have an understanding of computer programming

D. Operating ham radios or building stereo equipment or hobbies related to practical electronics are highly recommended for would-be technicians

E. Armed forces training programs in electronics also provide valuable experience

INFORMATION SHEET

X. **What to expect in the workplace**

A. Beginning repair technicians can expect to spend 3 to 6 months in some form of on-the-job training in a service center or a company training facility

B. Training will continue in elementary computer theory, computer math, circuitry theory, and component structure

C. The beginning technician will usually perform maintenance, continue training in operating computer equipment, and learn to use test equipment

D. Frequently, beginners work with experienced technicians until they are proficient in maintenance, troubleshooting, and repair

E. As beginners prove their talents, they are permitted to work alone with adequate supervision until they reach a point where they are competent to work without supervision

F. The beginner who exhibits dependability and expertize will eventually move to troubleshooting and repairing more sophisticated systems

XI. **Desired physical requirements for computer repair technicians**

A. Good close vision and normal color perception to work with small parts and color-coded wiring

B. A good sense of smell because detecting a burned out part can save a lot of troubleshooting time

C. Good hearing because some malfunctions can be detected because of irregular noises

D. General good health because busy repair facilities are frequently understaffed and it is difficult to replace someone who can't show up for work

XII. **Qualities that lead to advancement**

A. The ability to approach troubleshooting with a logical, analytical mind

(NOTE: Call this habit or a sixth sense, it separates a good repair technician from an average one because more than 80% of the time spent in repair work is the time it takes to find the problem.)

B. Both the ability and desire to read the technical and repair manuals for specific computers and peripherals, and to keep abreast of updates in all technical materials

C. The essential habit of keeping records of what is done, when it is done, what was used to do it, and all other records that are essential to both customer and employer

INFORMATION SHEET

D. The ability to work with people, especially customers, and especially customers with computer problems that are difficult to articulate

(NOTE: If you can keep your head while those around you are losing theirs and blaming it on Apple, IBM, Radio Shack, or some other computer manufacturer, you've got a great future as a computer repair technician.)

E. The habit of getting to work on time all the time is the best habit you can have, because dependability is as important as the skills you develop

XIII. **Where and how repair technicians work**

A. Many computer repair technicians work in local or area stores that sell and service computers and peripherals

B. Many computer repair technicians work for regional repair centers or computer manufacturers

C. The better jobs are generally in metropolitan areas because of the larger concentration of computers in these areas

D. Some organizations that have large computer operations in business or industry hire repair technicians to look after the systems

E. Some repair work requires travel within a limited area, but technicians are seldom gone overnight

F. Some technicians are required to obtain security clearances for work in restricted buildings in industry, government, or the military

G. At repair centers that operate 24 hours, technicians may be on shift work, and in other instances they may be on call or stand-by for emergency work

XIV. **Pay scales**

Skill Level	Average Weekly Pay
Beginning technician	$220
Fully trained technician	$240
Senior technician	$250 to $350
Highly skilled specialist	$300 to $400

(NOTE: Figures are taken from Bureau of Labor Statistics reports for 1978, and in most cases should be upgraded to reflect contemporary pay scales.)

INFORMATION SHEET

XV. **Related jobs and their skill requirements**

A. Field engineer — Requires basic to advanced skills and experience enough to help other technicians troubleshoot computer subsystems

B. Training supervisor — Requires basic to advanced skills and experience enough to teach systems and test equipment use to beginning technicians

C. Systems specialist — Requires advanced skills in system design, programming, and troubleshooting, and usually extensive knowledge of one major equipment line or specific components of a given system

D. Computer sales — Requires good people skills along with basic troubleshooting skills

(NOTE: Even beginning level repair technicians are naturals to move into sales and can advance that potential by encouraging customers to upgrade systems to avoid problems or to sign up for service contracts to assure priority repair service and save money.)

E. Management — Requires good people skills with both customers and employees, good troubleshooting skills, and basic skills in merchandising and advertising

XVI. **The ACID test for a successful technician**

A. A — Be concerned with your APPEARANCE; dress neatly and keep yourself well groomed because you will become part of the company image as you meet and work with customers

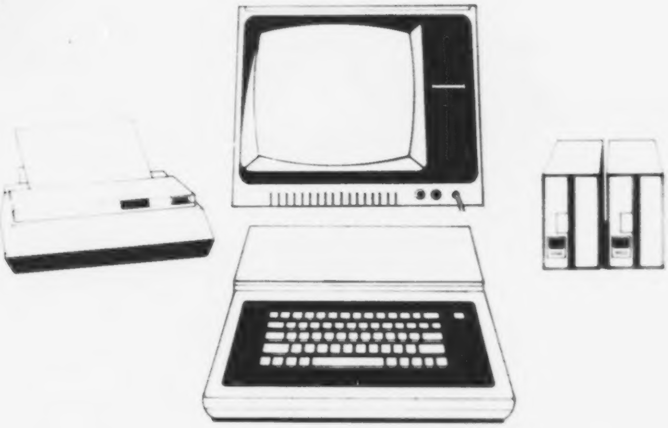
B. C — Be concerned with CUSTOMERS; good manners are the first rule in working with customers; and always remember that you will be working with them at a time when they may not be in the best of spirits

C. I — Learn to take INITIATIVE; develop the habit of working on your own without having to be supervised at every point or interrupting other busy people to ask for help unless you really need help

D. D — Be DEPENDABLE; get to work on time, be readily available when you are on stand-by, and earn your full day's pay with a full day's work

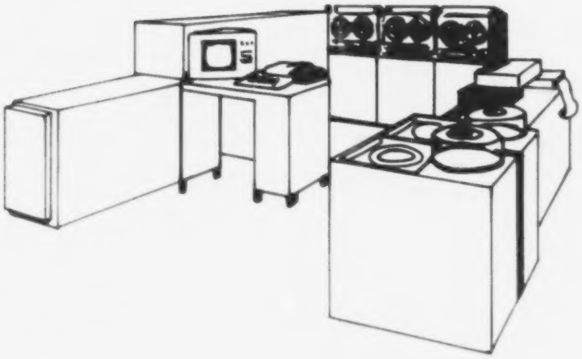
Major Types of Computers

Minicomputer



Microcomputer

Mainframe



COMPUTER HISTORY HIGHLIGHTS AND CAREER OVERVIEW
UNIT I

ASSIGNMENT SHEET #1 — USE THE ACID TEST TO RATE YOUR PERSONAL POTENTIAL AS A COMPUTER REPAIR TECHNICIAN

Directions: Answer the following questions honestly. Enter a number or zero for each question, then total your score and record it as indicated. Your test will not be seen by your instructor, but when the test is completed, your instructor will interpret class scores generally so all class members will, so to speak, know the score.

1. a. How many times have you had your hair cut or styled in the past year? a.__________

   b. How often do you take a bath or shower each week? b.__________

   c. How often have you seen your dentist in the past two years? c.__________

   d. How many new pieces of clothing, including shoes, have you acquired in the past year? d.__________

   e. On a scale of 1 to 10, with 10 being the highest, how do you think you look when you're really dressed up? e.__________

   TOTAL ALL ITEMS FROM QUESTION 1 AND ENTER HERE 1.__________

2. a. How many jobs have you had that required you to greet or work with customers? a.__________

   b. How often in the past year have you really lost your temper? b.__________

   c. When you argue, give yourself a 1 if you think you argue intelligently, a 2 if you think you get too emotional when you argue, and a 3 if you really have fun arguing. c.__________

   d. How many times in the past year have you helped an acquaintance, friend, or relative alleviate or solve a problem simply by talking with them? d.__________

   e. If you were a baseball official, give yourself a 3 if you'd like to be a home-plate ump and call balls and strikes, a 2 if you'd like to be a first-base ump, and a 1 if you'd like to be a third-base ump. e.__________

   TOTAL ALL ITEMS FROM QUESTION 2 AND ENTER HERE 2.__________

ASSIGNMENT SHEET #1

3. a. When it comes to going out with a friend to a movie or any activity, give yourself a 2 if you usually initiate the action and a 1 if you usually respond to invitations from others who invite you to come along. a.__________

b. How many times in the past year have you decided that something you use needed repairing and then fixed it yourself? b.__________

c. How many times in the past year have you called somebody long distance just to surprise them? c.__________

d. If there were a leaky faucet in your bathroom or kitchen, give yourself a 1 if you would call a plumber and have it repaired, a 2 if you would ask someone how to repair it, and then try to do it yourself, and a 3 if you would tackle the job all alone with no outside help. d.__________

e. Imagine you are trying to convince your best friend that you are a "go getter." Give yourself a 1 if your friend would laugh hysterically, a 2 if your friend would simply change the subject, and a 3 if your friend would admit that it is a quality evident in your behavior. e.__________

TOTAL ALL ITEMS FROM QUESTION 3 AND ENTER HERE 3.__________

4. a. How many times in the past year have you been late to school, or if not in school, how many times late to work, or if not working how many times late to anything? a.__________

b. Remember a time when you were late to school or work and give yourself a 1 if you presented the teacher or boss with a lousy excuse that you know was not believed, a 2 if you presented an excuse that was mostly accepted, and a 3 if you came up with an absolute lie that they swallowed hook, line, and sinker. b.__________

c. If you were going on a blind date, give yourself a 3 if you would dress up and be on time, a 2 if you would dress casually and be just a little late, or a 1 if you would pay no attention to how you dressed and show up late just to prove you're not too excited about the whole affair. c.__________

d. Give yourself a 3 if you come within a dollar of accounting for all the money you have spent in the past week, a 2 if you can come within five dollars, and a 1 if you think you'll miss the estimate by more than seven dollars. d.__________

ASSIGNMENT SHEET #1

e. On a scale of 1 to 10, with 10 being the highest, how would your friends rate your dependability factor? e.___________

TOTAL ALL ITEMS FROM QUESTION 4 AND ENTER HERE 4.___________

TOTAL ITEMS 1, 2, 3, AND 4 AND ENTER HERE ___________

COMPUTER HISTORY HIGHLIGHTS AND CAREER OVERVIEW
UNIT I

ANSWERS TO ASSIGNMENT SHEET

The major objective of this test is to determine the student's ability to read and follow directions carefully. As directions indicated, every item should be answered, items in each of the four sections should be subtotaled, and the grand total of items 1, 2, 3, and 4 should be the very last entry in the test. Any number left blank indicates a failure to follow instructions carefully.

1. With the exception of 1c, all items not answered with a minimum of 6 indicates a need for improvement in personal appearance or habits that promote good personal appearance, and anything less than a 6 on 1e indicates problems in self-esteem. If the total score on item 1 is less than 30, it points to habits and attitudes that need to be improved.

2. Anything less than a 5 as a total for item 2 indicates an introvert who may need to improve his or her verbal skills. A 3 as an answer to both 2c and 2e indicates good verbal skills and favorable self-esteem.

3. Anything less than a 5 as a total for item 3 indicates a lack of initiative. At least a 1 in item 3c indicates a concern for people, a good quality, and 1 is the perfect answer for 3e since it indicates appreciation for honesty in personal relationships.

4. Anything less than a 15 as a total for item 4 probably indicates a person who rationalizes too often, meaning that they may stretch the truth to justify attitudes or actions. A 2 on item 4b is the best answer because it indicates a flair for recognizing the difference between diplomacy and a white lie, and since 4c is not concerned with dependability at all, but one's attitudes toward people in general, the best answer would be a 3. And 4d is a question which reinforces the fact that we forget quickly and stresses the need for writing things down.

   Anything less than a 55 as a total score indicates attitudes and habits that need attention and improvement. And finally, anyone who didn't laugh, chuckle, or smile while taking the ACID test is in serious trouble.

COMPUTER HISTORY HIGHLIGHTS AND CAREER OVERVIEW
UNIT I

NAME ______________________

TEST

1. Match the terms on the right with their correct definitions.

______a. A shortened reference to a printed circuit board or the insulated surface on which circuit components are mounted and soldered in place

______b. A complete electronic circuit which may contain miniature resisters, transistors, diodes, and related circuitry all integrated into a miniature silicon base and mounted in a common housing

______c. An electronic device designed to make rapid, accurate computations from data programmed into it

______d. The arithmetic logic unit, registers, and timing and decoding circuitry usually contained in a single integrated circuit that controls computer activities

______e. The largest and most expensive computers designed specifically to serve business, industry, and government in applications that require mass storage and fast retrieval

______f. Medium-sized and medium-priced computers that rival the storage capacity and operating speed of smaller main-frames, and are used in business, industry, and government where they perform mostly dedicated or single-task activities

______g. The smallest and least expensive computers, designed for desk-top or portable use by an individual at home, yet versatile enough for applications in business, industry, and government

1. Peripheral
2. Minicomputers
3. Board
4. Prototype
5. Microcomputer
6. Main-frame computers
7. Microprocessor
8. Chip
9. Computer

TEST

______h. Any device such as a disk drive, printer, modem, or video display added to a basic microcomputer to provide increased capacity for handling, storing, or presenting data

______i. The first of its kind, the original from which later models are patterned

2. Match important persons with their contribution to early computer history.

______a. An Italian astronomer, mathematician, and physicist who is credited with the invention of the telescope which he used to prove that the planets rotate around the sun

______b. A French mathematician and physicist who in 1642 invented a mechanical calculator that performed addition and subtraction

______c. A self-taught English mathematician whose works with symbolic language proved that logic could be reduced to a simple algebraic system where all variables have the value of either zero or one

______d. An English mathematician who invented a "difference engine" and an "analytic engine" which are considered the true prototypes of modern computers

______e. A French inventor who designed a loom to weave pre-designed patterns with the use of punch cards

1. Pascal
2. Jacquard
3. Galileo
4. Babbage
5. Boole

TEST

3. Match milestones in American computer history with their dates.

______a. Herman Hollerith invented a punch card system using electromechanical relays, and the device was used in tabulating the 1890 U.S. census

______b. Claude Shannon of Bell Telephone Laboratories developed switching systems that used practical applications of Boolean algebra, and similar devices are still used in the Bell system and computers

______c. Howard Aiken and his staff at Harvard University completed the Mark I, the first totally automated computer, and one which worked with electromechanical relays

______d. Whirlwind I, a computer commissioned by the U.S. Navy to help solve problems in aircraft design, was completed, and is typical of much of the early American computer development that may never have happened without the commitment and funding of the U.S. military services

______e. Following several years of development, the ENIAC (Electrical Numerical Integrator and Computer) was put into operation by the U.S. Army, and is noteworthy because it handled information in the parallel mode

______f. Bell Telephone Laboratories invented the transistor, a device which revolutionized electronics in general and led to the solid-state circuitry in modern computers

______g. The first commercial computer was sold to the General Electric Company

______h. Following many years of development, the EDVAC (Electronic Discrete Variable Computer) was put into operation by the U.S. Army, and is noteworthy because it handled information in the serial mode and contained other programming concepts by John von Neumann, a scientist sometimes referred to as the Father of the modern computer

______i. The monolithic integrated circuit was invented, an event which gave computer design and computer circuitry a whole new direction totally different from anything that preceded it

1. 1946
2. 1952
3. 1890
4. 1944
5. 1927
6. 1949
7. 1944
8. 1952
9. 1961

TEST

4. Complete the following statements concerning milestones in microcomputer history by inserting the word(s) that best complete each statement.

   a. The ____________ ____________ which was introduced in 1975 by MITS is generally considered the first microcomputer and is credited with sparking the interest that started the microcomputer revolution

   b. Starting in ____________, three other major names first introduced microcomputers that all became popular:

      1) Tandy Radio Shack introduced the ____________

      2) Apple Computers introduced the ____________

      3) Commodore Business Machines introduced the ____________

   c. In ____________, IBM first marketed its ____________, a system that quickly set new standards in the industry and inspired over a dozen clones designed to work like the PC and run the many new items of software designed specifically for the IBM system

5. Select true statements concerning highlights in the history of microprocessor chips by placing an "X" in the appropriate blanks.

   _____a. A company known as VIATRON made the earliest attempt to build microcontroller chips in the late 1960's

   _____b. In 1970, INTEL introduced its 4004 and 8008 microprocessor chips

   _____c. In 1971, INTEL designed and produced the 8080 chip which was quickly adopted for general computer use

   _____d. In 1971, Motorola produced its 6800 microprocessor

   _____e. In 1972, MOS Technology produced its 6500 microprocessor

   _____f. In 1975, Zilog introduced the Z-80 microprocessor

   _____g. Major microprocessor chips have grown into chip families that have moved from the basic CPU chip to chips which are complete microcomputers with CPU, memory, and I/O functions integrated on one silicon chip

TEST

6. Complete the following statements concerning other significant elements in microcomputer history by inserting the word(s) that best completes each statement.

   a. The development of ____________ to support microcomputers has had a powerful impact on the microcomputer industry

      1) Specialized ____________ for ____________ has helped make the microcomputer an almost necessary piece of office equipment

      2) Specialized ____________ for games, education, and home management have increased computer sales in homes and ____________

   b. The expanded use of ____________ ____________ such as BASIC, dedicated to programming discreet information, opened the world of programming to almost anyone who wanted to have a go at it

7. Complete statements concerning the job outlook for computer repair technicians by inserting the word(s) that best completes each statement.

   a. Employment opportunities for computer repair technicians is expected to grow ____________ ____________ than the average for all occupations through the 1980's

   b. The demand for computer repair technicians will be close to ____________ higher than the supply of computer repair technicians throughout the 1980's

   c. Downturns in the national economy will ____________ ____________ computer repair technicians as it does other areas of employment such as construction jobs

   d. Of the five occupations projected for the highest growth rate between now and 1995, computer service technician is ________ ________ ________ ________ ________ ________

8. Differentiate between job classifications by placing an "X" beside the definition of a chip level technician.

   _____a. Usually works with some supervision in performing maintenance on microcomputers and peripherals and in completing troubleshooting routines to a point that malfunctioning boards or components can be identified, replaced, and sent to a repair center

   _____b. Usually works unsupervised, is capable of all board level activities, but also troubleshoots more complex internal problems and identifies, removes, and replaces chips and other malfunctioning parts on printed circuit boards

TEST

9. Select true statements concerning educational recommendations for computer repair technicians by placing an "X" in the appropriate blanks.

______a. Most employers require applicants to have a minimum of two years of training in basic electronics or electrical engineering, but few employers require an applicant to have a formal degree in electronics

______b. Students planning to work as computer repair technicians should have a good background in math and a basic understanding of physics

______c. Computer repair technicians should have an understanding of auto mechanics

______d. Operating ham radios or building stereo equipment or hobbies related to practical electronics are highly recommended for would-be technicians

______e. Armed forced training programs in electronics also provide valuable experience

10. Complete the following statements concerning what to expect in the workplace by inserting the word(s) that best completes each statement.

a. Beginning repair technicians can expect to spend 3 to 6 months in some form of ________ ________ ________ training in a service center or a company training facility

b. Training will continue in elementary computer theory, computer ____________, circuitry theory, and component structure

c. The beginning technician will usually perform maintenance, continue training in operating computer equipment, and learn to use ____________ equipment

d. Frequently, beginners work with experienced technicians until they are proficient in maintenance, ____________, and repair

e. As beginners prove their talents, they are permitted to work alone with adequate supervision until they reach a point where they are competent to work ____________ supervision

f. The beginner who exhibits dependability and expertise will eventually move to troubleshooting and repairing more ____________ ____________

11. Complete the following list of desired physical requirements for computer repair technicians by inserting the word(s) that best completes each statement.

a. Good close ____________ and normal ____________ perception to work with small parts and color-coded wiring

b. A good sense of ____________ because detecting a burned out part can save a lot of troubleshooting time

TEST

c. Good ____________ because some malfunctions can be detected because of irregular noises

d. General ____________ ____________ because busy repair facilities are frequently understaffed and it is difficult to replace someone who can't show up for work

12. Complete the following statements concerning qualities that lead to advancement by inserting the word(s) that best completes each statement.

a. The ability to approach troubleshooting with a ____________, analytical mind

b. Both the ability and desire to ____________ the technical and repair manuals for specific computers and peripherals, and to keep abreast of ____________ in all technical materials

c. The essential habit of ____________ ____________ of what is done, when it is done, what was used to do it, and all other records that are essential to both customer and employer

d. The ability to ________ ________ ________, especially customers, and especially customers with computer problems that are difficult to articulate

e. The habit of getting to work on time all the time is the best habit you can have, because ____________ is as important as the skills you develop

13. Select true statements concerning where and how repair technicians work by placing an "X" in the appropriate blanks.

_____a. Many computer repair technicians work in local or area stores that sell and service computers and peripherals

_____b. Many computer repair technicians work for regional repair centers or computer manufacturers

_____c. The better jobs are generally in small towns

_____d. Some organizations that have large computer operations in business or industry hire repair technicians to look after the systems

_____e. Some repair work requires travel within a limited area and technicians are frequently gone overnight

_____f. Some technicians are required to obtain security clearances for work in restricted buildings in industry, government, or the military

_____g. At repair centers that operate 24 hours, technicians may be on shift work, and in other instances they may be on call or stand-by for emergency work

TEST

14. Complete the following chart of pay scales by inserting the appropriate information.

Skill Level	Average Weekly Pay
Beginning technician	a.
Fully trained technician	b.
c.	$250 to $350
Highly skilled specialist	d.

15. Match related jobs with their skill requirements.

______a. Requires basic to advanced skills and experience enough to help other technicians troubleshoot computer subsystems

______b. Requires basic to advanced skills and experience enough to teach systems and test equipment use to beginning technicians

______c. Requires advanced skills in system design, programming, and troubleshooting, and usually extensive knowledge of one major equipment line or specific components of a given system

______d. Requires good people skills along with basic troubleshooting skills

______e. Requires good people skills with both customers and employees, good troubleshooting skills, and basic skills in merchandising and advertising

1. Training supervisor
2. Management
3. Computer sales
4. Field engineer
5. Systems specialist

TEST

16. Complete the following statements concerning the ACID test for a successful technician by inserting the word(s) that best completes each statement.

    a. A — Be concerned with your ________________; dress neatly and keep yourself well groomed because you will become part of the company image as you meet and work with customers

    b. C — Be concerned with ________________; good manners are the first rule in working with customers; and always remember that you will be working with them at a time when they may not be in the best of spirits

    c. I — Learn to take ________________; develop the habit of working on your own without having to be supervised at every point or interrupting other busy people to ask for help unless you really need help

    d. D — Be ________________; get to work on time, be readily available when you are on stand-by, and earn your full day's pay with a full day's work

(NOTE: If the following activity has not been completed prior to the test, ask your instructor when it should be completed.)

17. Use the ACID test to rate your personal potential as a computer repair technician. (Assignment Sheet #1)

COMPUTER HISTORY HIGHLIGHTS AND CAREER OVERVIEW
UNIT I

ANSWERS TO TEST

1. a. 3
   b. 8
   c. 9
   d. 7
   e. 6
   f. 2
   g. 5
   h. 1
   i. 4

2. a. 3
   b. 1
   c. 5
   d. 4
   e. 2

3. a. 3
   b. 5
   c. 4 or 7
   d. 4 or 7
   e. 1
   f. 6
   g. 2 or 8
   h. 2 or 8
   i. 9

4. a. Altair 8800
   b. 1977
      1) TRS-80
      2) Apple
      3) Pet
   c. 1981, PC

5. a,b,c,d,e,f,g

6. a. Software
      1) Software, business
      2) Software, schools
   b. Programming languages

7. a. Much faster
   b. 50%
   c. Not affect
   d. At the top of the list

8. b

9. b,d,e

ANSWERS TO TEST

10. a. On-the-job
    b. Math
    c. Test
    d. Troubleshooting
    e. Without
    f. Sophisticated systems

11. a. Vision, color
    b. Smell
    c. Hearing
    d. Good health

12. a. Logical
    b. Read, updates
    c. Keeping records
    d. Work with people
    e. Dependability

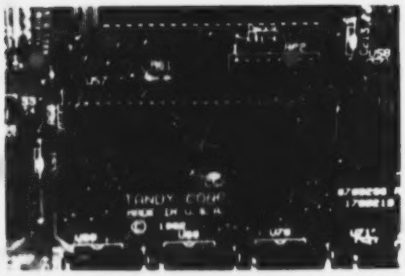
13. a,b,d,f,g

14. a. $220
    b. $240
    c. Senior technician
    d. $300 to $400

15. a. 4
    b. 1
    c. 5
    d. 3
    e. 2

16. a. Appearance
    b. Customers
    c. Initiative
    d. Dependable

17. Evaluated to the satisfaction of the instructor



MICROCOMPUTER OVERVIEW
UNIT II

UNIT OBJECTIVE

After completion of this unit, the student should be able to name the basic components of a microcomputer and discuss the function of CPU's, registers, busses, memory, I/O chips, and clocks. The student should also be able to list chip families and discuss operating systems, levels of language, and numbering systems. These competencies will be evidenced by correctly performing the procedures outlined in the assignment sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to microcomputer overview with their correct definitions.
2. Match common computer-related abbreviations with their meanings.
3. Match basic microcomputer components with their functions.
4. Complete statements concerning CPU sections and their functions.
5. Complete definitions of types of busses.
6. Select true statements concerning other characteristics of busses.
7. Match memory devices with their definitions.
8. Complete statements concerning clock and timing characteristics.
9. Arrange in order steps in a microcomputer operating cycle.
10. Complete a list of components of a chip family.
11. Complete statements concerning chip pinouts.
12. Arrange in order the steps in reading a pinout.
13. Identify abbreviations and other conventions for labeling pinouts.
14. Arrange in order the steps in typical chip family evolution.
15. Select true statements concerning general I/O chips.
16. Select true statements concerning specialized I/O chips.
17. Complete statements concerning directions in chip family evolution.

OBJECTIVE SHEET

18. Complete a list of functions of an operating system program.
19. List types of operating systems.
20. Select true statements concerning characteristics of disk operating systems.
21. Match typical disk operating systems with their uses.
22. Solve problems concerning identification of disk operating systems.
23. Complete statements concerning the importance of DOS identification in troubleshooting.
24. Match types of printers with their characteristics.
25. Complete statements concerning types of disk drives.
26. Select true statements concerning modems and their characteristics.
27. Complete statements concerning video displays and their characteristics.
28. Complete statements concerning specialized peripherals.
29. Match levels of language with their orders.
30. Select true statements concerning characteristics of machine language.
31. Complete statements concerning characteristics of assembler language.
32. Complete statements concerning characteristics of traditional high level languages.
33. Select true statements concerning characteristics of applications languages.
34. Complete statements concerning characteristics of applications software.
35. Match numbering systems with their structures.
36. Convert binary numbers to decimal numbers and decimal numbers to binary numbers. (Assignment Sheet #1)
37. Convert octal numbers to binary and decimal numbers and binary and decimal numbers to octal numbers. (Assignment Sheet #2)
38. Convert hexadecimal numbers to binary and decimal numbers and binary and decimal numbers to hexadecimal numbers. (Assignment Sheet #3)
39. Convert decimal numbers into binary, hexadecimal, and binary coded decimal numbers. (Assignment Sheet #4)
40. Label a pinout for a microprocessor. (Assignment Sheet #5)

MICROCOMPUTER OVERVIEW
UNIT II

SUGGESTED ACTIVITIES

A. Provide student with objective sheet.

B. Provide student with information and assignment sheets.

C. Make transparencies.

D. Discuss unit and specific objectives.

E. Demonstrate to the class the procedure for booting up a disk-based operating system.

F. Have available various types of IC chips, a microprocessor, ROM, RAM, and others as they are available, so students can see how a dual-in-line package is put together.

G. Demonstrate with one of the IC's how the pins are numbered and how the notch at the top of the chip serves as a guide to finding pin #1.

H. Demonstrate to the class how to use the DOS in booting up a disk-based microcomputer system.

I. Demonstrate the use of machine language and assembler language to the class and then compare it with a comparable program in BASIC or any other higher level language, and use the demonstration to reinforce the "binary" and "hexidecimal" numbering systems and their importance to microcomputer operations.

J. Give test.

CONTENTS OF THIS UNIT

A. Objective sheet

B. Information sheet

C. Transparency masters

  1. TM 1 — IC Pinouts From a Computerfacts™ Schematic

  2. TM 2 — Microprocessor Evolution

  3. TM 3 — Numbering Systems Table

D. Assignment sheets

  1. Assignment Sheet #1 — Convert Binary Numbers to Decimal Numbers and Decimal Numbers to Binary Numbers

CONTENTS OF THIS UNIT

2. Assignment Sheet #2 — Convert Octal Numbers to Binary and Decimal Numbers and Binary and Decimal Numbers to Octal Numbers

3. Assignment Sheet #3 — Convert Hexadecimal Numbers to Binary and Decimal Numbers and Binary and Decimal Numbers to Hexidecimal Numbers

4. Assignment Sheet #4 — Convert Decimal Numbers Into Binary, Hexadecimal, and Binary Coded Decimal Numbers

5. Assignment Sheet #5 — Label a Pinout for a Microprocessor

E. Answers to assignment sheets

F. Test

G. Answers to test

REFERENCES USED IN DEVELOPING THIS UNIT

A. *Desktop Computer Z-100 Series User's Manual.* St. Joseph, MI 49085: Zenith Data Systems, 1983.

B. *DOS User's Manual.* Cupertino, CA 95014: Apple Computers, Inc., 1983.

C. *Model 4 Disk System Owner's Manual.* Fort Worth, TX 76102: Radio Shack, a Division of Tandy Corporation, 1983.

D. *Sams Computerfacts™ CC5, COMPUTER: Atari 400™.* Indianapolis, IN 46206: Howard W. Sams & Co., Inc., 1984.

E. *Component Data Catalog.* Santa Clara, CA 95051: Intel Corporation, 1982.

MICROCOMPUTER OVERVIEW
UNIT II

INFORMATION SHEET

I. **Terms and definitions**

A. Abbreviation — A word or phrase usually formed from the first letter in each word or a group of words

Example: CPU means **C**entral **P**rocessing **U**nit

B. Acronym — A word or phrase usually formed from the first few letters of each word in a group of words

Examples: FORTRAN means **For**mula **Tran**slation

C. Bit — One binary digit, the smallest unit of information a digital computer can handle

D. Byte — Eight bits that can be arranged to represent any decimal number from 0 to 255

E. Nibble — Half a byte or four bits that can be arranged to represent any decimal number from 0 to 15

F. Megabyte — One million bytes, a way of measuring the highly expanded memory capacity of some microcomputers using 16-bit microprocessors

G. Mnemonics (pronounced knee-mon-ics) — The use of devices to improve memory, and with microcomputers, it is the letter codes used in certain logic functions to change higher level languages into machine language

II. **Common computer-related abbreviations and their meanings**

A. ALU — Arithmetic logic unit

B. BCD — Binary coded decimal

C. CPU — Central processing unit

D. DOS — Disk operating system

E. IC — Integrated circuit

F. I/O — Input/output

G. RAM — Random access memory

H. ROM — Read only memory

INFORMATION SHEET

I. PROM — Programmable read only memory

J. EPROM — Erasable programmable read only memory

III. Microcomputer components and their functions

A. CPU — The heart of the microcomputer system where the ALU and control sections are located along with the registers used to handle data (Figure 1)

FIGURE 1

CPU in a Hewlett-Packard Trainer

B. Registers — Internal devices where stored information is manipulated as blocks of characters

C. Busses — The system of wires or printed circuits used to connect the CPU to the remainder of the subsystem

D. Memory — The section of the microcomputer that provides permanent or temporary storage for binary information

E. I/O chips — Devices designed to interface the microprocessor with peripherals (Figure 2)

FIGURE 2

I/O chips in a Hewlett-Packard Trainer

INFORMATION SHEET

F. Clock — The timing signal that the CPU uses to time all logic operations

IV. **CPU sections and their functions**

A. Control section:

1. Receives binary instructions from the data bus and decodes them

2. Uses clock timing to set up appropriate registers to handle decoded instructions

3. Handles clock timing and interrupt line inputs

B. Register section:

1. Program counter — This register is the same binary word length as the address and controls the step-by-step progress as the CPU executes a program

2. Accumulator — This register accesses the ALU unit where all math and Boolean logic functions are executed

(NOTE: The name "accumulator" is derived from the way the device "accumulates" an answer following a logic or arithmetic operation.)

3. Index register — This register has the unique ability to change its content value by one either up or down depending on instructions sent to it, and there may be more than one such register

4. Flag register — This register has individual bit positions which indicate the status or changes in a process after each instruction

Example: If a register contains zero after a given instruction, the zero status flag will "go high"

5. Stack pointer — This register keeps track of where the microprocessor stores (stacks) the contents of the working registers when the microcomputer is interrupted

(NOTE: The interrupt may be from an external source or an internal function that moves the program counter, but in both cases, the contents of working registers are stacked in RAM during interrupts and subroutine functions.)

V. **Types of busses**

A. Address bus — A set of parallel wires or printed circuit traces that carry the binary signal from the CPU to address or select the location of memory or an I/O device in the system

INFORMATION SHEET

B. Data bus — A set of parallel wires or printed circuit traces that carry the binary signal from or to the CPU in response to a read/write command from the CPU

(NOTE: The data bus is the same binary word length as the data or instruction word(s) used by the microprocessor.)

C. Control bus — The bus that distributes the control signals required to keep things in order and running smoothly

VI. **Other characteristics of busses**

A. There are several types of external busses, and their architecture varies with the specific applications for which they are designed

B. An entire bus may be multiplexed so that a bus with several lines can serve more than one signal source

C. Both the address and data busses carry parallel signals at clock speeds in excess of 1 megahertz, and troubleshooting bus problems requires an oscilloscope-type device known as a data analyzer

(NOTE: An ordinary oscilloscope is not a good choice for trying to troubleshoot bus problems because the best ones can view only two waveforms, and thorough troubleshooting requires viewing 8 or 16 waveforms.)

VII. **Memory devices and their definitions**

A. ROM — Memory devices that have programs permanently stored in them by the manufacturer and remain stored when the power is off

(NOTE: This type of memory is sometimes called a mask ROM and is used in the system to control functions fundamental to system operation so there is no need for reprogramming each time the system is booted up.)

B. PROM — A ROM device that can be programmed by a user to store information only once, sometimes called a fusible PROM, and programs remain in storage when power is off

C. EPROM — A ROM device that can be erased by ultraviolet light and reprogrammed by a user, and programs remain in storage when power is off

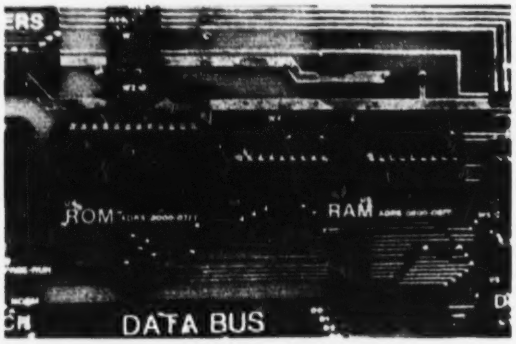
D. Static read/write memory (SRAM) — Retains stored contents until it is altered or power is turned off

INFORMATION SHEET

E. Dynamic read/write memory (DRAM) — Retains stored contents only one to two milliseconds, must be continually refreshed if it is to keep its contents while power is on, and loses all contents when power is turned off (Figure 3)

(NOTE: Because of the "refresh circuits," dynamic memory systems are difficult to troubleshoot, but they are popular because their density takes up less physical space.)

FIGURE 3



ROM and RAM chips in a Hewlett-Packard Trainer

VIII. Clock and timing characteristics

A. Timing of a microprocessor or microcomputer system is accomplished with an IC clock circuit either on the microprocessor chip or on a separate chip circuit

B. The clock waveform is usually a two phase nonoverlapping type with two signals at the same frequency but starting at different times

C. When one waveform is high the other is low, and these waveforms are usually labeled phase one (high) and phase two (low)

D. The clock provides timing signals to all parts of the microsystem and does not have to be addressed because it is "on-line" all of the time

E. It is important to remember that the CPU controls the system busses but that the clock controls timing to all of the parts so that if the CPU or the clock either one fails the system will be inoperative

F. The high-speed timing cycle can be manipulated by use of an "interrupt" mechanism activated by an operator or an outside control device to slow operations to "real time"

INFORMATION SHEET

IX. Steps in a microcomputer operating cycle

A. Before a program can be executed, the program counter must be set to a memory location selected to begin the program

(NOTE: This command may be in hexadecimal to address the CPU directly in machine language or the command may be in a high level language which is decoded into machine language through an interpreter or assembler.)

B. The CPU places the contents of the program counter on the ADDRESS BUS as the PROGRAM COUNTER proceeds to the next sequential memory location where it will stop until it receives instructions from the CPU decoder section

C. The ADDRESS BUS selects the contents of memory specified and places whatever binary instruction it finds onto the DATA BUS

(NOTE: All of this is happening in a timed cycle, and remember that the program counter is waiting for instructions from the CPU decoder section.)

D. The DATA BUS carries its data to the INSTRUCTION REGISTER of the CPU

(NOTE: Since the first word on the data bus enters the instruction register, it must be an INSTRUCTION WORD.)

E. In the CPU, the DECODER sets up the appropriate REGISTERS in response to the INSTRUCTION WORD that was placed in the INSTRUCTION REGISTER

(NOTE: Each of the operations in the operating cycle is timed by the system clock, and the number of clock cycles may vary with different CPUs.)

F. After the REGISTERS are set up, one of two operations normally occur:

1. The CPU may execute the program directly if no further data is required

2. The CPU may require that the program counter send another address out on the system ADDRESS BUS to retrieve data from another memory address which may be required to complete the instruction cycle

   (NOTE: It is extremely important to understand the concept of an operating cycle because it is the key to why old troubleshooting techniques cannot be used with microprocessors.)

INFORMATION SHEET

X. **Components of a chip family**

- A. Microprocessor chip

  (NOTE: The microprocessor is the heart of the chip family because it determines the bus width which may be a 4-bit, 8-bit, or 16-bit design.)

- B. Memory chips
- C. Clocking function chips
- D. General purpose I/O chips
- E. Applications or specialized I/O chips

XI. **Chip pinouts** (Transparency 1)

- A. A chip pinout is a block diagram that shows individual pin locations on a chip along with abbreviations or symbols to indicate pin functions
- B. Since chip pinouts are valuable troubleshooting tools, they should be found in OEM technical materials, and should be a part of every schematic that includes chips in the circuitry
- C. Chip pinouts of microprocessors are especially helpful because they provide quick references to pins where critical power supply, interrupt, and timing signals can be checked

XII. **Steps in reading a pinout**

- A. Look for a notch or indentation at or near the end of the chip

  (NOTE: This indentation is a mark to help locate pin #1, and it may be shaped like a half moon, it may be circular, or it may be a notch, but it will be evident.)

- B. Imagine yourself looking at the chip with the unmarked end of the chip at the bottom and the indentation at the top
- C. Locate pin #1 in the top left hand corner of the chip, to the left of the indentation
- D. Locate pin #2 immediately below pin #1, and locate all other pins in order on the left side of the chip moving down
- E. Cross over to the lower right hand corner of the chip and locate all remaining pins in order on the right hand side of the chip moving up
- F. Verify a proper pinout reading by making sure the largest pin number is in the upper right hand corner of the chip opposite pin #1

INFORMATION SHEET

XIII. **Abbreviations and other conventions for labeling pinouts**

A. A0 through A15 indicate address lines

B. D0 through D7 indicate data lines

C. $\phi0$ indicates clock in

D. $\phi1$ and $\phi2$ indicate clock out

E. $\overline{\text{IRQ}}$ indicates an interrupt request

F. $\overline{\text{NMI}}$ indicates a nonmaskable interrupt

G. $\overline{\text{RES}}$ indicates a reset

H. RDY indicates ready

I. NC means a pin has no connection

J. R/W indicates read/write

K. A bar above an abbreviation indicates the line is active in a low logic state

Example: $\overline{\text{IRQ}}$, $\overline{\text{NMI}}$, and $\overline{\text{RES}}$

L. VCC indicates +5V

M. VSS indicates a voltage supply source

N. GND indicates ground

(NOTE: There are many other abbreviations used for labeling pins, and since they vary from chip to chip, it's always best to find the proper OEM technical material to properly identify pin functions.)

XIV. **Steps in typical chip family evolution**

A. Most chip families started with a microprocessor that needed additional I/O and controller chips

Example: INTEL's 8080 microprocessor required not only memory and I/O chips, but also an 8224 timing chip and an 8228 controller chip

B. The next chip generation integrated certain timing and control functions with the microprocessor

Example: INTEL's 8085 did not require additional timing and controller chips

INFORMATION SHEET

C. The next chip generation became a complete microcomputer on a silicon chip

Example: INTEL's 8048 includes not only the microprocessor, but memory, I/O, timer, and controller functions

D. Following generations of chips were made for specialized functions

Example: INTEL's 8748, an EPROM (Erasable Programmable Read Only Memory) can be programmed by the computer manufacturer or erased and programmed by an individual computer operator, and the INTEL 8022 is typical of highly specialized microcomputers on a chip designed with analog conversions to control devices such as microwave ovens that require temperature sensing.

XV. General I/O chips

A. I/O chips send and receive data to and from peripherals in two ways:

1. Parallel
2. Serial

B. A parallel handling device will take an entire 4, 8, or 16-bit word all at once internally

C. A serial handling device will take the bits in a word one at a time whether sending or receiving

D. One timing cycle (clock cycle) will take an entire word in parallel

E. One timing cycle (clock cycle) will take only one bit of a word in serial

(NOTE: Because serial handling is asyncronous with system timing, it runs slower than system timing, serial data transfer is safer for data transmission because only one bit of a word can be lost at a time, but with parallel data transfer, the whole word or several words may be lost.)

XVI. Specialized I/O chips

A. Often include timing for specific functions such as data transfer and realtime (clock timing) functions

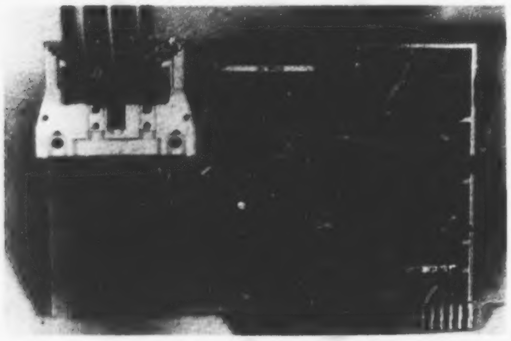
Example: The IEEE-488 GPIB, General Purpose Interface Bus, was specifically designed interfacing between laboratory instruments and computers

INFORMATION SHEET

B. Add-on controls or integrated peripherals

1. Floppy disk controller
2. Data communications devices such as MODEMs
3. Video controller chips
4. Printer and keyboard interfaces (Figure 4)

FIGURE 4



5. Memory control

C. Provide coprocessing capability such as a math coprocessor like Intel's 8087 which works much faster than the microprocessor and also frees the microprocessor for other program functions

(NOTE: Memory cards perform special functions, but they are such generally used parts and manufactured by so many manufacturers that they are not specialized in the sense that chip families are.)

XVII. **Directions in chip family evolution** (Transparency 2)

A. The production of larger word length microprocessors

Example: INTEL's 8088 is internally a 16-bit microprocessor, but it can accept 8-bit words off the traditional 8-bit data bus, and this microprocessor is the heart of IBM and IBM look-alike computers

INFORMATION SHEET

B. The production of more sophisticated microprocessors to fill industrial and commercial needs

Example: INTEL has produced a 32-bit microprocessor called the IAPX which means Intel Advanced Products Experimental, and is a good indication of how chip manufacturers will continue to experiment and enhance both chip functions and capabilities

(NOTE: As you advance in troubleshooting skills you will confront most of the major chip families which include INTEL, Motorola, TI, National, MOS Technology, MOSTECK, Rockwell, Fairchild, and Zilog.)

XVIII. **Functions of an operating system program**

A. To power up computer

B. To read the keyboard and generate a video display

C. To accept operating signals from the hardware and relate them to whatever level of software is being used

D. To knit together the hardware and software functions to permit a user to operate a computer system

XIX. **Types of operating systems**

A. Disk operating systems

B. Nondisk operating systems

(NOTE: Nondisk operating systems may be on tape or may be in ROM so that the computer comes up "smart" shortly after the computer is turned on.)

XX. **Characteristics of disk operating systems**

A. Part of the operations still take place in ROM

B. Must be able to do the same tasks an operating system normally does

C. Must also be able to handle storage and retrieval of information on the mass storage disk

XXI. **Typical disk operating systems and their uses**

A. Apple DOS — Used with Apple computers

(NOTE: Apple DOS is a trademark of Apple Computers.)

B. TRSDOS — Used with TRS (Tandy Radio Shack) computers

(NOTE: TRSDOS is a trademark of Tandy Radio Shack.)

INFORMATION SHEET

C. PCDOS — Used with the IBM personal computer

(NOTE: PCDOS is a trademark of IBM.)

D. MSDOS — An operating system developed by MicroSoft Corporation

(NOTE: Microsoft is a registered trademark and MS is a trademark of Microsoft Corporation.)

E. CP/M — Control Program for Microcomputers, the first attempt to make a generic DOS that would work with any computer

(NOTE: CP/M is a registered trademark of Digital Research, Inc.)

F. UNIX — A sophisticated multi-task/multi-user DOS that requires a 16-bit microprocessor and is typical of the coming generation of operating systems

(NOTE: UNIX is a trademark of AT&T Technologies, Inc.)

G. Z-DOS — Used with the Zenith Z100 microcomputer

(NOTE: Z-DOS is a trademark of Zenith Data Systems.)

XXII. **Identification of disk operating systems**

A. First generation DOS's normally have a single number followed by a dot and a zero

Example: DOS 1.0

B. Major modifications of the DOS retain the number before the dot, but change the number following the dot

Example: 1.1 is the first revision of DOS 1.0

C. Minor modifications of the DOS retain the number before the dot and the number after the dot, but add second or even third digits after the dot to indicate further minor changes

Example: DOS 1.123

D. When the operating system undergoes a complete change, the number in front of the dot is changed

Example: DOS 2.0

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XXIII. Importance of DOS identification in troubleshooting

A. An upgraded DOS is designed to correct problems in an operating system, and a customer not using a properly updated DOS may be having problems that have already been corrected with the DOS change

B. When troubleshooting, make sure you are using the same DOS the customer has been using, and that it is the proper DOS

C. Computer customers should be encouraged to register their computers at the time of purchase because some manufacturers automatically send notification of DOS modifications

XXIV. Types of printers and their characteristics

A. Dot matrix — Versatile printers in that they can reproduce standard typewriter symbols plus graphics, but limited in that the quality of reproduction is less than excellent even on the best types

(NOTE: Earlier dot-matrix printers did not produce letter-quality print, but newer models do, and some of them rival the performance of their letter-quality cousins.)

B. Letter quality — Reproduce typewriter symbols with superior quality by using a strike-on head, printer ball, or a daisy wheel, but cannot reproduce graphics

C. Ink jet — Reproduce quality typewriter symbols with excellent quality because the jet-spray pattern closes characters well, and also capable of good graphics

(NOTE: The ink jet printer, although relatively new, is highly accepted not only because of its quality, but its near silent operating characteristics.)

D. Laser — Ultra high-speed printers that produce a quality that only professional printing can rival, but their cost is prohibitive and their use is limited

XXV. Types of disk drives

A. Floppy — Operates with a soft pliable oxide-coated disk in standard sizes of 8", 5 1/4", and 3 1/2"

B. Hard — Operates with a hard oxide-coated disk that comes in a variety of styles and sizes, but the 5 1/4" size is most common because it can replace a floppy disk of the same size and work at a much faster speed

(NOTE: Hard disks are attractive for some applications because of their great storage capacity which can sometimes be one hundred times greater than a floppy of the same size.)

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XXVI. **Modems and their characteristics**

A. Modems are devices which permit one computer to communicate with another computer via a phone line or direct wire

B. Modems are mostly manufactured with dedicated IC chips and have relatively few serviceable components

C. Because modems are electronic transmitting devices, they are strictly controlled by FCC regulations, and some modern repair is restricted only to holders of an appropriate FCC license, and the fines for violation of FCC rules are severe

XXVII. **Video displays and their characteristics**

A. Monochrome — May be black and white, green, or amber, and may be integrated with the computer system or an add-on

B. Composite color — Usually an add-on video display less expensive than an RGB, but lacking the high resolution of an RGB and may not be capable of an 80-column display

C. RGB — A color monitor that separates red, green, and blue for quality high resolution, and can handle an 80-column display and still retain a clear display

(NOTE: Both composite color displays and RGB displays are usually add-ons and sometimes require printed circuit card changes for proper operation.)

XXVIII. **Specialized peripherals**

A. Speech generators

B. Real time clocks

C. Spoolers for printing

   1. Supplies data to the printer while the computer is still running

   2. Frees computer memory so computer can continue in use while data is being printed

D. Plotters for charts, graphs, and other special graphic and drafting applications

E. Graphic input devices

   1. The mouse

   2. The light pen

   3. Graphics pads or tablets of several varieties

INFORMATION SHEET

F. Specialized applications cards such as robotic controls and communications controls for phone answering devices

(NOTE: Most specialized peripherals are not serviced and some are not serviceable at all because they use large IC's that can be replaced only by the manufacturer.)

XXIX. **Levels of language and their orders**

A. Machine language — The first or lowest language level

B. Assembler language — The second or next lowest language level

C. Program language — The next to highest language level

(NOTE: These languages include BASIC, FORTRAN, COBOL, PASCAL, and many others.)

D. Applications language — The highest language level

(NOTE: These languages consist of already programmed items such as spread sheets and word processing programs that permit the user to cause some operation to occur by simply entering data as opposed to programming the computer.)

XXX. **Characteristics of machine language**

A. Requires that the computer operator specify actual memory addresses in the computer along with machine codes that are understood by the computer control section

B. Requires data necessary for the operation at the level the computer can understand which is typically binary or hexidecimal

C. Requires that an operator know the codes and the addressing modes of the instructions for a specific microcomputer chip because each chip has a different set of codes

D. In servicing computers, there are times when machine language routines are the only way to operate the system

(NOTE: In fact, if communications to the outside are not functional, this is the only way to get the microprocessors to respond.)

E. Most system troubleshooting routines are written in machine language

F. Is the slowest to program of all language, but runs the fastest

INFORMATION SHEET

XXXI. **Characteristics of assembler language**

A. Replace machine codes with mnemonics or "memory devices"

B. Mnemonics are usually three or four-letter codes and are usually abbreviations for the operation to be performed

Example: ADC means add with carry, LDA means load the accumulator, and ROR means rotate right

C. Addressing in assembly language is done by "labeling" rather than giving specific machine addresses

D. After a program is written in assembly language, the mnemonics and labels must be run through a program called an "assembler"

E. The assembler program will in turn generate the machine code which in turn will operate the computer

F. Assembler language is easier to learn than machine language because it is more generic in nature and does not require learning specific codes for a given chip

(NOTE: This generic quality of assembly language means that a program could be done on a host computer, in other words, written on one brand of computer and used on another brand of computer that might use a distinctly different brand of chip.)

G. Is about ten times faster to write than machine language

XXXII. **Characteristics of traditional high level languages**

A. These programs are highly structured, but once the operator learns the rules, programming in a high level language such as BASIC or PASCAL becomes a relatively easy job

B. The computer deals with a high level language by translating the language into machine language through an interpreter or a compiler

C. With an interpreter, the BASIC command along with line number and data is fed into the interpreter ROM which then sends the interpreted machine language instructions to the microprocessor

1. Interpreters are built into most home computers

2. Since the interpreter must look up every BASIC instruction, the process is slow, but the interpreter is still the most common way of handling high level languages

INFORMATION SHEET

D. With a compiler, the high level BASIC commands are fed into a compiler program which interprets and compiles data directly into machine language

  1. Compilers are not part of basic computer systems and have to be purchased as add-ons

  2. Since the compiler translates high level languages into machine language, it is much faster than an interpreter

XXXIII. **Characteristics of applications languages**

A. Extremely user friendly in that they permit an operator to complete a routine by simply entering data, but no formal programming is required

B. Some applications languages such as spread sheets and word processing programs offer menu choices and even "help" options to assure that errors will be avoided

(NOTE: Do not confuse an applications program with the language that makes it function because the program is designed around a special applications language that makes the program work.)

XXXIV. **Characteristics of applications software**

A. Applications software is almost always "dedicated" to performing one specific function

Example: Process controls, robotic controls, and analytical laboratory controls

B. Because most applications software is tied-in to sensor input, no operator input is required

Example: Applications software that operates the fuel-ignition system in an automobile receives input from various sensors as well as the accelerator, interprets all inputs, and selects the correct fuel mixture and ignition timing for the most efficient operation at any given speed

XXXV. **Numbering systems and their structures** (Transparency 3)

A. Decimal — A numbering system with a base of 10 that uses the digits 0 through 9 to represent all numbers in the system

Example: Most numbers used in every day life and business are decimal numbers

INFORMATION SHEET

B. Binary — A numbering system with a base of 2 that uses only the digits 0 and 1 to represent all numbers in the system

Example: Moving left, each place value in the binary system doubles in value, and that is what is meant by a base 2 numbering system

128		64		32		16		8		4		2		1
	x2		x2		x2		x2		x2		x2		x2	

When a 0 appears in a place value, there is no number value, but when a 1 appears in a place value, the number value is equal to the place value and the number value is the total of all the place values that have a 1 in them

1024	512	256	128	64	32	16	8	4	2	1	
0	0	0	0	0	0	0	1	0	1	0	= 10
0	0	1	0	0	0	0	0	0	0	0	= 256
0	0	1	1	1	1	1	1	1	0	0	= 508

(NOTE: In other words, in the binary system, only one of two things can happen, a 1 will indicate a given place value and a 0 will indicate no value, and this basic idea of only one of two things happening is the heart of computer logic systems where things are either "on" or "off" or "high" or "low".)

INFORMATION SHEET

C. Hexadecimal — A numbering system with a base of 16 which uses the digits 0 through 9 to represent the numbers 0 through 9 and the letters A through F to represent the numbers 10 through 15

Example: Since place values in a 16-base numbering system are multiplied by 16 instead of 2 as in a binary system, they're fairly easy to figure out. To find the hexadecimal value of 3E8, start right or left and add the totals; starting from left to right it would work as follows:

8 + (E × 16) + (3 × 256) =

8 + (14 × 16) + (3 × 256) =

8 + 224 + 768 = 1000

(NOTE: The binary form for 256 is 1 0000 0000, but the hexadecimal form is 100, so in effect, the hexadecimal form "crunches" numbers to make them easier for a computer user to read and use, and the computer can readily convert hexidecimal numbers to binary form.)

D. BCD (binary coded decimal) — A numbering system that assigns a four-digit binary code to each digit in a decimal number

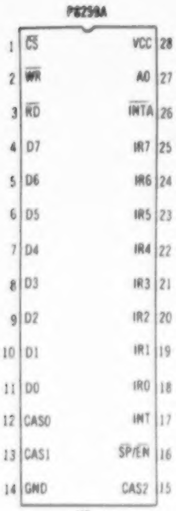
Example: Since the value of each decimal number is represented by a four-digit binary number, the values of each four-digit binary are determined separately and placed together in order

Binary coded decimal	0010	0101	0110
Decimal	2	5	6

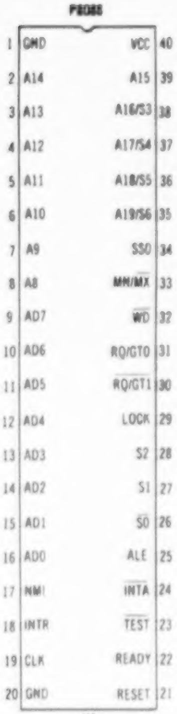
(NOTE: Since the binary code for 256 is 1 0000 0000, it is obvious that the BCD code takes more bits to represent the same thing and thus requires more circuits, but the BCD is important because it provides operators with a facility for working with their familiar base 10 numbering system.)

E. Octal — A number system with a base of 8 that was (and is) used in some early microcomputers

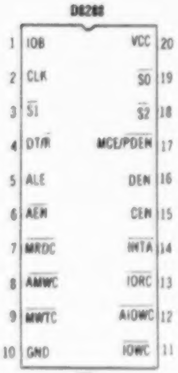
IC Pinouts From a Computerfacts™ Schematic



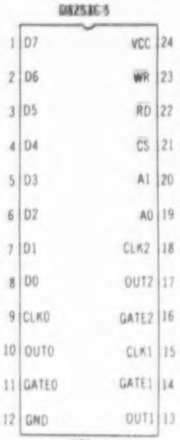
U2
INTERRUPT CONTROLLER
TOP VIEW



U3
CPU
TOP VIEW



U6
BUS CONTROLLER
TOP VIEW



U34
TIMER
TOP VIEW

Courtesy Howard W. Sams & Co., Inc.

Microprocessor Evolution

Year	Product and Significance
1972	Intel introduced its 8008 microprocessor which was an 8-bit microprocessor designed to be used as a machine controller IC, but it became popular with hobbyists who built their own computers.
1974	Intel introduced its 8080 microprocessor which was an 8-bit microprocessor designed with three power supplies, +5V, +12V, and -5V. Clock was on a separate chip. Was "stack oriented" and normally capable of 64K bytes of memory or 128K using stack status.
1977	Intel introduced its 8085 microprocessor which was an 8-bit microprocessor designed with only one +5V power supply and further improved with an integrated clock. Was normally capable of 64K bytes of memory or 128K using stack status.
1978-79	Intel introduced its 8086 and 8088 microprocessors which were the first of the new 16-bit microprocessors although the 8088 has a special bus structure that allows it to read 8-bit words to facilitate its use with popular 8-bit wide peripheral and memory chips. Capable of up to one megabyte of memory.

Numbering Systems Table

DECIMAL	BINARY	HEXADECIMAL	BCD
0	0000	0	0000
1	0001	1	0001
2	0010	2	0010
3	0011	3	0011
4	0100	4	0100
5	0101	5	0101
6	0110	6	0110
7	0111	7	0111
8	1000	8	1000
9	1001	9	1001
10	1010	A	0001 0000
11	1011	B	0001 0001
12	1100	C	0001 0010
13	1101	D	0001 0011
14	1110	E	0001 0100
15	1111	F	0001 0101

MICROCOMPUTER OVERVIEW
UNIT II

ASSIGNMENT SHEET #1 — CONVERT BINARY NUMBERS TO DECIMAL NUMBERS AND DECIMAL NUMBERS TO BINARY NUMBERS

A. Conversion from binary to decimal

1. Position values in the numeral are based on the right-to-left progression of powers of 2 (2^0, 2^1, 2^2, 2^3, etc.)

2. The rightmost position has a value of 1; the next position, a value of 2; the next, 4; the next, 8; the next, 16; etc. (Table 1)

2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
16284	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1

Place Values of Binary Numerals
Table 1

(NOTE: The conversion of binary numbers to decimal numbers is called expanded notation.)

3. Position values of the original numeral are written out and then added

Example: The conversion of 100110 to its decimal equivalent is 38

$$100110 = (1 \times 2^5) + (0 \times 2^4) + (0 \times 2^3) + (1 \times 2^2) + (1 \times 2^1) + (0 \times 2^0)$$

$$= 32 + 0 + 0 + 4 + 2 + 0$$

$$= 38 \text{ (decimal)}$$

4. Write the decimal numerals equivalent to the following binary numerals.

a. 1101 ______________________

b. 100110 ______________________

c. 0101101 ______________________

d. 110011000 ______________________

B. Conversion from decimal to binary

(NOTE: Conversion from decimal numbers to binary numbers is called the division-multiplication method.)

1. Divide the number repeated by the value of 2

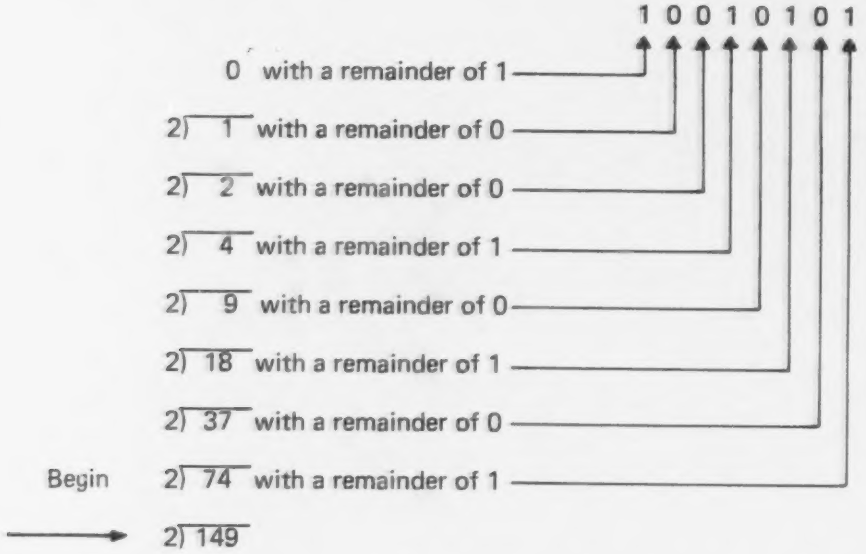
(NOTE: This method is similar to other base systems: simply divide the number to be converted by the value of the base to which the number is being converted.)

ASSIGNMENT SHEET #1

2. The division operation is repeated until the quotient is 0

3. The remainders are written in reverse of the order in which they were obtained and form the binary number

Example: The conversion of decimal numeral 149 to its binary equivalent is 10010101


1 0 0 1 0 1 0 1
0 with a remainder of 1
2) 1 with a remainder of 0
2) 2 with a remainder of 0
2) 4 with a remainder of 1
2) 9 with a remainder of 0
2) 18 with a remainder of 1
2) 37 with a remainder of 0
Begin 2) 74 with a remainder of 1
2) 149

4. Write, in the blank following each decimal, the equivalent binary numeral.

a. 7________________

b. 16________________

c. 43________________

d. 62________________

MICROCOMPUTER OVERVIEW
UNIT II

ASSIGNMENT SHEET #2 — CONVERT OCTAL NUMBERS TO BINARY AND DECIMAL NUMBERS AND BINARY AND DECIMAL NUMBERS TO OCTAL NUMBERS

A. Conversion from binary to octal

1. Write binary number on sheet of paper
2. Begin at right-most digit and mark off groups of three bits, continuing until you reach the left-most bit position

   (NOTE: Each group uses the value of 2 to the 2nd, 1st, and 0 powers.)

3. Write down the decimal equivalent of each group of three binary digits

   Example: Octal equivalent of binary number 010011101

Sum of place values	2 =	3 =	5 =
Value of 2 raised to 2nd, 1st, and 0 power	0 + 2 + 0	0 + 2 + 1	4 + 0 + 1
Place value	2^2 2^1 2^0	2^2 2^1 2^0	2^2 2^2 2^0
Binary number	0 1 0	0 1 1	1 0 1
Octal equivalent no.	2	3	5

B. Conversion from octal to binary

1. Any one octal digit represents three binary digits
2. Write the equivalent binary digits under each octal digit

   Example: Octal number 235 is expressed as 010011101 in binary

2 3 5
Λ Λ Λ
010 011 101

or 235 (octal) = 010011101 (binary)

C. Conversion from octal to decimal

1. May use same technique used for converting binary to decimal
2. Position values of the original numeral are written out and then added

   Example: The conversion of the octal number to its decimal equivalent is 459

$$713 = (7 \times 8^2) + (1 \times 8^1) + (3 \times 8^0)$$

$$= 488 + 8 + 3$$

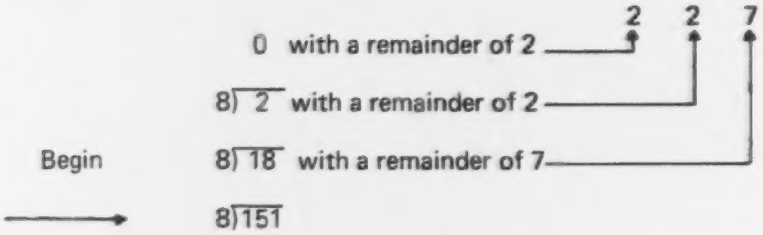
$$= 459 \text{ (decimal)}$$

ASSIGNMENT SHEET #2

D. Conversion from decimal to octal

1. Use same technique used for converting decimal-to-binary
2. Number is repeatedly divided by the value 8

Example: The conversion of decimal numeral 151 to octal equivalent is 227



E. Convert the following numbers as indicated.

1. 010011 binary = ______________________________ octal
2. 011110101 binary = ______________________________ octal
3. 235 octal = ______________________________ binary
4. 23 octal = ______________________________ binary
5. 714 octal = ______________________________ decimal
6. 559 decimal = ______________________________ octal

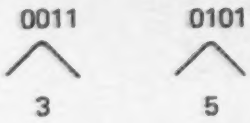
MICROCOMPUTER OVERVIEW
UNIT II

ASSIGNMENT SHEET #3 — CONVERT HEXADECIMAL NUMBERS TO BINARY AND DECIMAL NUMBERS AND BINARY AND DECIMAL NUMBERS TO HEXADECIMAL NUMBERS

A. Conversion of binary to hexadecimal

1. Similar to conversion of binary to octal
2. Group binary numbers in fours beginning at the right-most number, and continuing until the left-most number is reached
3. Write down the decimal equivalent of each group of four binary digits

Example: Hexadecimal equivalent of binary number 00110101

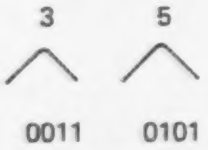


or 00110101 (binary) = 35 (hexadecimal)

B. Conversion of hexadecimal to binary

1. Any one hexadecimal digit represents four binary digits
2. Write the equivalent binary digits under each hexidecimal digit

Example: Hexadecimal number 35 is expressed as 00110101



or 35 (hexadecimal)= 0110101 (binary)

C. Conversion of hexadecimal to decimal

1. May use same technique used for converting binary to decimal
2. Position values of the original numeral are written out and then added

Example: The conversion of A5 to its decimal equivalent is 165

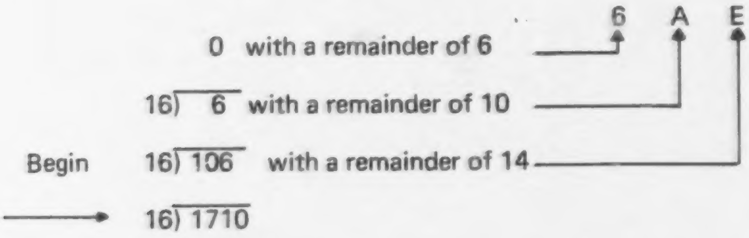
$$\begin{aligned} A5 &= (10 \times 16^1) + (5 \times 16^0) \\ &= 160 + 5 \\ &= 165 \text{ (decimal)} \end{aligned}$$

ASSIGNMENT SHEET #3

D. Conversion of decimal to hexadecimal

1. Use same technique used for converting decimal to binary
2. Number is repeatedly divided by the value 16

Example: The conversion of decimal numeral 1710 to hexadecimal numeral is 6AE


6 A E
0 with a remainder of 6
16) 6 with a remainder of 10
Begin 16) 106 with a remainder of 14
16) 1710

E. Assume that the following hexadecimal numerals appear on a printout of the contents of the storage unit of a computer. For each numeral, show the binary digits that are stored in the computer.

1. FF15A903________________________
2. 75C4DE31________________________

F. Write, in the blank following each decimal numeral, the hexadecimal numeral that is equivalent to it.

1. 8________________________
2. 12________________________
3. 432________________________
4. 1698________________________

MICROCOMUTER OVERVIEW
UNIT II

ASSIGNMENT SHEET #4 — CONVERT DECIMAL NUMBERS INTO BINARY, HEXADECIMAL, AND BINARY CODED DECIMAL NUMBERS

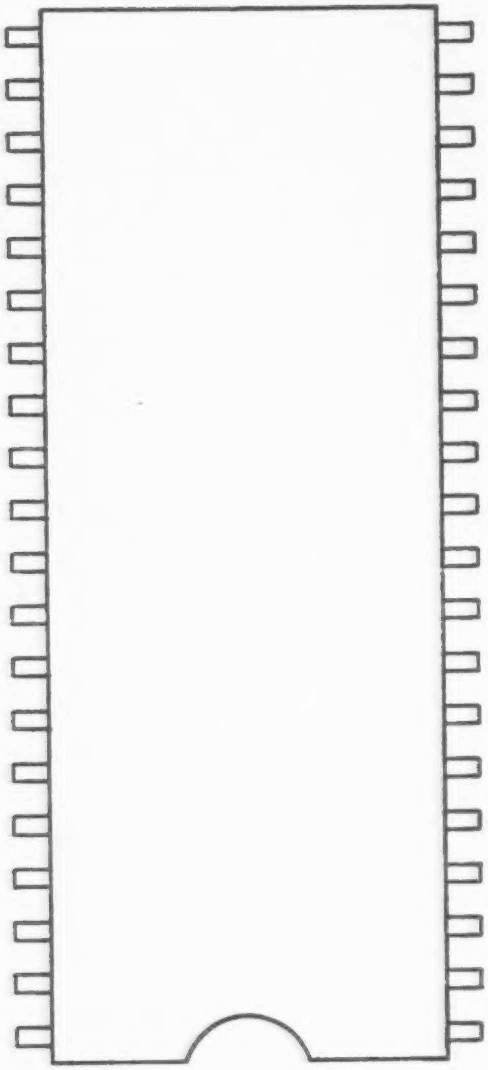
Directions: Convert the following decimal numbers to the numbering systems indicated in each column.

Decimal	Binary	Hexadecimal	BCD
12			
39			
256			
751			
508			
454			
1000			
927			
512			
884			
329			
1024			

MICROCOMUTER OVERVIEW
UNIT II

ASSIGNMENT SHEET #5 — LABEL A PINOUT FOR A MICROPROCESSOR

Directions: Label the pins in proper order on the microprocessor depicted in the block diagram below.



MICROCOMPUTER OVERVIEW
UNIT II

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

A. 4. a. $1101 = (1 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0)$

$= 8 + 4 + 0 + 1$

$= 13$

b. $100110 = (1 \times 2^5) + (0 \times 2^4) + (0 \times 2^3) + (1 \times 2^2) + (1 \times 2^1) + (0 \times 2^0)$

$= 32 + 0 + 0 + 4 + 2 + 0$

$= 38$

c. $0101101 = (0 \times 2^6) + (1 \times 2^5) + (0 \times 2^4) + (1 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0)$

$= 0 + 32 + 0 + 8 + 4 + 0 + 1$

$= 45$

d. $110011000 = (1 \times 2^8) + (1 \times 2^7) + (0 \times 2^6) + (0 \times 2^5) + (1 \times 2^4) + (1 \times 2^3) +$

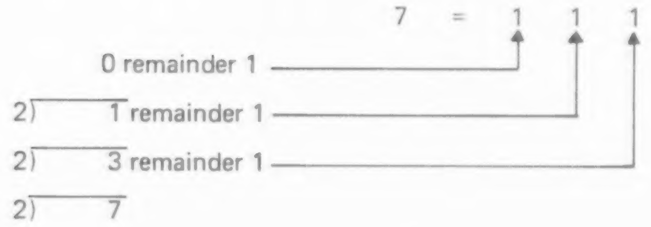
$(0 \times 2^2) + (0 \times 2^1) + (0 \times 2^0)$

$= 256 + 128 + 0 + 0 + 16 + 8 +$

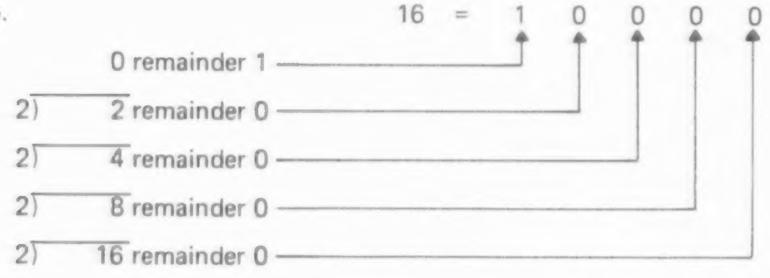
$0 + 0 + 0$

$= 408$

B. 4. a.



b.



ANSWERS TO ASSIGNMENT SHEETS

c. 43 = 1 0 1 0 1 1

0 remainder 1
2) 1 remainder 0
2) 2 remainder 1
2) 5 remainder 0
2) 10 remainder 1
2) 21 remainder 1
2) 43

d. 62 = 1 1 1 1 1 0

0 remainder 1
2) 1 remainder 1
2) 3 remainder 1
2) 7 remainder 1
2) 15 remainder 1
2) 31 remainder 0
2) 62

Assignment Sheet #2

E. 1. 23
2. 365
3. 010011101
4. 010011
5. 460
6. 1057

Assignment Sheet #3

E. 1. 1111 1111 0001 0101 1010 1001 0000 0011
2. 0111 0101 1100 0100 1101 1110 0011 0001

F. 1. 8
2. C
3. 1BO
4. 6A2

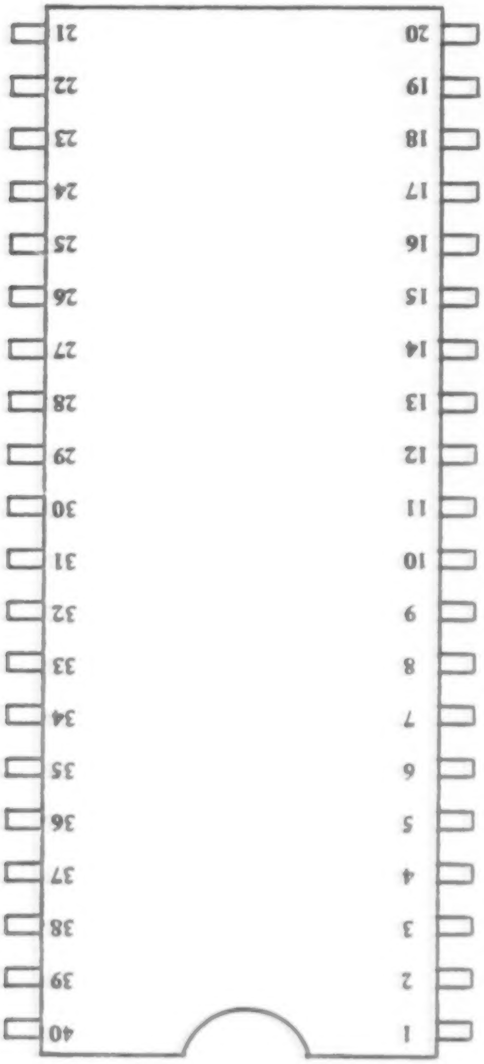
ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #4

Decimal	Binary	Hexadecimal	BCD
12	1100	C	0010 0010
39	100111	27	0011 1001
256	100000000	100	0010 0101 0110
751	1011101111	2EF	0111 1010 0001
508	111111100	1FC	1010 0000 1000
454	111000110	1C6	0100 0101 0100
1000	1111101000	3E8	0001 0000 0000 0000
927	1110011111	39F	1001 0010 0111
512	1000000000	200	0101 0001 0010
884	1101110100	374	1000 1000 0100
329	101001001	149	0011 0010 1001
1024	10000000000	400	0001 0000 0010 0100

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #5



MICROCOMPUTER OVERVIEW
UNIT II

NAME ______________________

TEST

1. Match the terms on the right with their correct definitions.

______a. A word or phrase usually formed from the first letter in each word or group of words

______b. A word or phrase usually formed from the first few letters in a group of words

______c. One binary digit, the smallest unit of information a digital computer can handle

______d. Eight bits that can be arranged to represent any decimal number from 0 to 255

______e. Half a byte or four bits that can be arranged to represent any decimal number from 0 to 15

______f. One million bytes, a way of measuring the highly expanded memory capacity of some microcomputers using 16-bit microprocessors

______g. The use of devices to improve memory, and with microcomputers, it is the letter codes used in certain logic functions to change higher level languages into machine language

1. Mnemonics
2. Megabyte
3. Acronym
4. Abbreviation
5. Bit
6. Byte
7. Nibble

2. Match common computer-related abbreviations with their meanings.

______a. Arithmetic logic unit
______b. Binary coded decimal
______c. Central processing unit
______d. Disk operating system
______e. Integrated circuit
______f. Input/output
______g. Random access memory
______h. Read only memory
______i. Programmable read only memory
______j. Erasable programmable read only memory

1. RAM
2. BCD
3. DOS
4. ROM
5. ALU
6. EPROM
7. PROM
8. IC
9. I/O
10. CPU

TEST

3. Match basic microcomputer components with their functions.

_____a. The heart of the microcomputer system where the ALU control sections are located along with the registers used to handle data

_____b. Internal devices where stored information is manipulated as blocks of characters

_____c. The system of wires or printed circuits used to connect the CPU to the remainder of the subsystem

_____d. The section of the microcomputer that provides permanent or temporary storage for binary information

_____e. Devices designed to interface the microprocessor with peripherals

_____f. The timing signal that the CPU uses to time all logic operations

1. Busses
2. Clock
3. CPU
4. Memory
5. Registers
6. I/O chips

4. Complete the following statements concerning CPU sections and their functions by inserting the word(s) that best complete each statement.

a. Control section:

1) Receives binary instructions from the data bus and ____________ them

2) Uses clock timing to set up appropriate ____________ to handle decoded instructions

3) Handles clock timing and ____________ line inputs

b. Register section:

1) Program counter — This register is the same binary word length as the address and controls the ____________-____________-____________ ____________ as the CPU executes a program

2) Accumulator — This register accesses the ____________ unit where all math and Boolean logic functions are executed

3) Index register — This register has the unique ability to change its content value by ____________ either up or down depending on instructions sent to it, and there may be more than one such register

4) Flag register — This register has individual bit positions which indicate the ____________ or ____________ in a process after each instruction

5) Stack pointer — This register keeps track of where the microprocessor stores the contents of the working registers when the microcomputer is ____________

TEST

5. Complete the following definitions of types of busses by inserting the word(s) that best complete each statement.

   a. Address bus — A set of parallel wires or printed circuit traces that carry the binary signal from the CPU to ____________ or ____________ the location of memory or an I/O device in the system

   b. Data bus — A set of parallel wires or printed circuit traces that carry the binary signal from or to the CPU in response to a ____________/____________ command from the CPU

6. Select true statements concerning other characteristics of busses by placing an "X" in the appropriate blanks.

   _____a. There are several types of external busses, and their architecture varies with the specific applications for which they are designed

   _____b. An entire bus may be multiplexed so that a bus with several lines can serve more than one signal source

   _____c. Both the address and data busses carry parallel signals at clock speeds in excess of 1 megahertz, and troubleshooting bus problems requires a good voltmeter

7. Match memory devices with their definitions.

   _____a. Memory devices that have programs permanently stored in them by the manufacturer and remain stored when power is off

   _____b. A ROM device that can be programmed by a user to store information only once, sometimes called a fusible PROM, and programs remain in storage when power is off

   _____c. A ROM device that can be erased and reprogrammed by a user, and programs remain in storage when power is off

   _____d. Retains stored contents until it is altered or power is turned off

   _____e. Retains stored contents only one to two milliseconds, must be continually refreshed if it is to keep its contents while power is on, and loses all contents when power is turned off

   1. Static read/write memory (SRAM)
   2. ROM
   3. Dynamic read/write memory (DRAM)
   4. PROM
   5. EPROM

TEST

8. Complete the following statements concerning clock and timing characteristics by inserting the word(s) that best completes each statement.

   a. Timing of a microprocessor or microcomputer system is accomplished with an ____________ ____________ ____________ either on the microprocessor chip or on a separate chip circuit

   b. The clock ____________ is usually a two phase nonoverlapping type with two signals at the same frequency but starting at different times

   c. When one waveform is high the other is ____________, and these waveforms are usually labeled phase one (high) and phase two (low)

   d. The clock provides timing signals to all parts of the microsystem and does not have to be addressed because it is ____________-____________ all of the time

   e. It is important to remember that the CPU controls the system busses but that the clock controls timing to all of the parts so that if the CPU or the clock either one fails the system will be ____________

   f. The high-speed timing cycle can be manipulated by use of an "interrupt" mechanism activated by an operator or an outside control device to slow operations to ____________ ____________

9. Arrange in order steps in a microcomputer operating cycle by placing the correct sequence number in the appropriate blank.

   _____a. In the CPU, the DECODER sets up the appropriate REGISTERS in response to the INSTRUCTION WORD that was placed in the INSTRUCTION REGISTER

   _____b. After the REGISTERS are set up, one of two operations normally occur:

      1) The CPU may execute the program directly if no further data is required

      2) The CPU may require that the program counter send another address out on the system ADDRESS BUS to retrieve data from another memory address which may be required to complete the instruction cycle

   _____c. The ADDRESS BUS selects the contents of memory specified and places whatever binary instruction it finds onto the DATA BUS

   _____d. The DATA BUS carries its data to the INSTRUCTION REGISTER of the CPU

   _____e. Before a program can be executed, the program counter must be set to a memory location selected to begin the program

   _____f. The CPU places the contents of the program counter on the ADDRESS BUS as the PROGRAM COUNTER proceeds to the next sequential memory location where it will stop until it receives instructions from the CPU decoder section

TEST

10. Complete the following list of components of a chip family by inserting the word(s) that best complete each chip type

a. ________________ chip

b. ________________ chips

c. Clocking ________________ chips

d. General purpose ________________ chips

e. Applications or ________________ I/O chips

11. Complete the following statements concerning chip pinouts by inserting the word(s) that best completes each statement.

a. A chip pinout is a block diagram that shows individual pin locations on a chip along with ____________ or ____________ to indicate pin functions

b. Since chip pinouts are valuable troubleshooting tools, they should be found in OEM technical materials, and should be a part of every ____________ that includes chips in the circuitry

c. Chip pinouts of microprocessors are especially helpful because they provide ____________ ____________ to pins where critical power supply, interrupt, and timing signals can be checked

12. Arrange in order the steps in reading a pinout by placing the correct sequence number in the appropriate blank.

_____a. Locate pin #2 immediately below pin #1, and locate all other pins in order on the left side of the chip moving down

_____b. Imagine yourself looking at the chip with the unmarked end of the chip at the bottom and the indentation at the top

_____c. Look for a notch or indentation at or near the end of the chip

_____d. Cross over to the lower right hand corner of the chip and locate all remaining pins in order on the right hand side of the chip moving up

_____e. Locate pin #1 in the top left hand corner of the chip, to the left of the indentation

_____f. Verify a proper pinout reading by making sure the largest pin number is in the upper right hand corner of the chip opposite pin #1

TEST

13. Identify abbreviations and other conventions for labeling pinouts by inserting the word(s) that best complete each statement.

    a. A0 through A15 indicate ____________ lines

    b. D0 through D7 indicate ____________ lines

    c. $\phi 1$ and $\phi 2$ indicate ____________ ____________

    d. $\overline{\text{RES}}$ indicates ____________

    e. RDY indicates ____________

    f. R/W indicates ____________/____________

    g. A ____________ above an abbreviation indicates the line is active in a low logic state

    h. VCC indicates ____________

    i. GND indicates ____________

14. Arrange in order the steps in typical chip family evolution by placing the correct sequence number in the appropriate blank.

    _____a. Most chip families started with a microprocessor that needed additional I/O and controller chips

    _____b. The next chip generation became a complete microcomputer on a silicon chip

    _____c. The next chip generation integrated certain timing and control functions with the microprocessor

    _____d. Following generations of chips were made for specialized functions

15. Select true statements concerning general I/O chips by placing an "X" in the appropriate blanks.

    _____a. I/O chips send and receive data to and from peripherals in two ways:

      1) Parallel

      2) Serial

    _____b. A parallel handling device will take an entire 4, 8, or 16-bit word all at once internally

    _____c. A serial handling device will take the bits in a word one at a time whether sending or receiving

    _____d. One timing cycle (clock cycle) will take an entire word in serial

    _____e. One timing cycle (clock cycle) will take only one bit of a word in parallel

TEST

16. Select true statements concerning specialized I/O chips by placing an "X" in the appropriate blanks.

_____a. Often including timing for specific functions such as data transfer and real time functions

_____b. Add-on controls or integrated peripherals

1) Floppy disk controller

2) Data communications devices such as MODEMs

3) Video controller chips

4) Printer and keyboard interface

5) Memory control

_____c. Provide coprocessing capability such as a math coprocessor like Intel's 8087 which works much faster than the microprocessor and also frees the microprocessor for other program functions

17. Complete the following statements concerning directions in chip family evolution by inserting the word(s) that best complete each statement.

a. The production of larger ____________ ____________ microprocessors

b. The production of more sophisticated ____________ to fill industrial and commercial needs

18. Complete the following list of functions of an operating system by inserting the word(s) that best completes each statement.

a. To ____________ ____________ the computer

b. To ____________ the keyboard and generate a ____________ display

c. To accept operating signals from the ____________ and relate them to whatever level of software is being used

d. To ____________ together the hardware and software functions to permit a user to operate a computer system

19. List the types of operating systems.

a. ____________

b. ____________

TEST

20. Select true statements concerning characteristics of disk operating systems by placing an "X" in the appropriate blanks.

______a. Part of the operations still take place in RAM

______b. Must be able to do the same tasks an operating system normally does

______c. Must also be able to handle storage and retrieval of information on the mass storage disk

21. Match typical disk operating systems and their uses.

______a. Used with Apple computers

______b. Used with TRS (Tandy Radio Shack) computers

______c. Used with the IBM personal computer

______d. MicroSoft

______e. Control Program for Microcomputers, the first attempt to make a generic DOS that would work with any computer

______f. A sophisticated multi-tasking/multi-user DOS that requires a 16-bit microprocessor and is typical of the coming generation of operating systems

______g. Used with the Zenith Z100 microcomputer

1. TRSDOS
2. Z-DOS
3. MSDOS
4. Apple DOS
5. CP/M
6. PCDOS
7. UNIX

22. Solve the following problems concerning identification of disk operating systems.

a. Would a DOS numbered 1.123 indicate a major or a minor change?

Answer: ____

b. If there were previously a DOS 1.1, but a new DOS 2.0 is issued, what does it mean?

Answer: ____

c. What would DOS 1.0 usually indicate?

Answer: ____

TEST

23. Complete the following statements concerning the importance of DOS identification in troubleshooting by inserting the word(s) that best complete each statement.

    a. An upgraded DOS is designed to correct problems in an operating system, and a customer not using a properly updated DOS may be having problems that have already been corrected with the ____________ ____________

    b. When troubleshooting, make sure you are using the same DOS the customer has been using, and that it is then ____________ ____________

    c. Computer customers should be encouraged to ____________ their computers at the time of purchase because some manufacturers automatically send notification of DOS modifications

24. Match types of printers with their characteristics.

______a. Versatile printers in that they can reproduce standard typewriter symbols plus graphics, but limited in that the quality of reproduction is less than excellent even on the best types

______b. Reproduce typewriter symbols with superior quality by using a strike-on head, printer ball, or a daisy wheel, but cannot reproduce graphics

______c. Reproduce quality typewriter symbols with excellent quality because the jet-spray pattern closes characters well, and also capable of good graphics

______d. Ultra high-speed printers that produce a quality that only professional printing can rival, but their cost is prohibitive and their use is limited

1. Laser
2. Dot matrix
3. Ink jet
4. Letter quality

25. Complete the following statements concerning types of disk drives by inserting the word(s) that best completes each statement.

    a. Floppy -- Operates with a soft pliable ____________ ____________ disk in standard sizes of 8", 5 1/4", and 3 1/2"

    b. Hard — Operates with a hard oxide-coated disk that comes in a variety of styles and sizes, but the 5 1/4" size is most common because it can ____________ ____________ ____________ ____________ ____________ ____________ ____________ ____________ and work at a much faster speed

TEST

26. Select true statements concerning modems and their characteristics by placing an "X" in the appropriate blanks.

_____a. Modems are devices which permit one computer to communicate with another computer via a phone line or direct wire

_____b. Modems are mostly manufactured with dedicated IC chips and have many serviceable components

_____c. Because modems are electronic transmitting devices, they are strictly controlled by FCC regulations, and some modem repair is restricted only to holders of an appropriate FCC license, and the fines for violation of FCC rules are severe

27. Complete the following statements concerning video displays and their characteristics by inserting the word(s) that best completes each statement.

a. ________________ — May be black and white, green, or amber, and may be integrated with the computer system or an add-on

b. ________________ — Usually an add-on video display less expensive than an RGB, but lacking the high resolution of an RGB and may not be capable of an 80-column display

c. ________________ — A color monitor that separates red, green, and blue for quality high resolution, and can handle an 80-column display and still retain a clear display

28. Complete the following statements concerning specialized peripherals by inserting the word(s) that best completes each statement.

a. Speech ____________

b. Real time ____________

c. Spoolers for printing

    1) Supplies data to the printer while the computer is ____________ ____________

    2) Frees computer memory so computer can continue in use while data is ____________ ____________

d. Plotters for charts, graphs, and other special graphic and ____________ applications

e. Graphic input devices

    1) The ____________

    2) The ____________ pen

    3) Graphics pads or ____________ of several varieties

f. Specialized applications cards such as ____________ controls and communications controls for ____________ answering devices

TEST

29. Match levels of language with their orders.

_____a. The first or lowest language level

_____b. The second or next lowest language level

_____c. The next to highest language level

_____d. The highest language level

1. Assembler language
2. Program language
3. Applications language
4. Machine language

30. Select true statements concerning characteristics of machine language by placing an "X" in the appropriate blanks.

_____a. Requires that the computer operator specify actual memory addresses in the computer along with machine codes that are understood by the computer control section

_____b. Requires data necessary for the operation at the level the computer can understand which is typically binary or hexidecimal

_____c. Requires that an operator know the codes and the addressing modes of the instructions for a specific microcomputer chip because each chip has a different set of codes

_____d. In servicing computers, there are times when machine language routines are the only way to operate the system

_____e. Most system troubleshooting routines are written in machine language

_____f. Is the fastest to program of all languages, but runs the slowest

31. Complete the following statements concerning characteristics of assembler language by inserting the word(s) that best completes each statement.

a. Replaces machine codes with mnemonics or _____________ _____________

b. Mnemonics are usually three or four-letter codes and are usually _____________ for the operation to be performed

c. Addressing in assembly language is done by _____________ rather than giving specific machine addresses

d. After a program is written in assembly language, the mnemonics and labels must be run through a program called an _____________

e. The assembler program will in turn generate the _____________ code which in turn will operate the computer

f. Assembler language is easier to learn than _____________ language because it is more generic in nature and does not require learning specific codes for a given chip

g. Is about _____________ times faster to write than machine language

TEST

32. Complete the following statements concerning characteristics of traditional high level languages by inserting the word(s) that best completes each statement.

    a. These programs are highly structured, but once the operator learns the rules, programming in a high level language such as BASIC or PASCAL becomes a relatively ____________ job

    b. The computer deals with a high level language by translating the language into machine language through an ____________ or ____________

    c. With an interpreter, the BASIC command along with line number and data is fed into the interpreter ROM which then sends the interpreted machine language instructions to the ____________

    d. With a compiler, the high level BASIC commands are fed into a compiler program which interprets and compiles data directly into ____________ language

        1) Compilers are not part of basic computer systems and have to be ____________ ____________ ____________ ____________

        2) Since the compiler translates high level languages into machine language, it is much ____________ than an interpreter

33. Select true statements concerning characteristics of applications languages by placing an "X" in the appropriate blanks.

    _____a. Extremely user friendly in that they permit an operator to complete a routine by simply entering data, but no formal programming is required

    _____b. Some applications languages such as spread sheets and word processing programs offer menu choices and even "help" options to assure that errors will be avoided

34. Complete the following statements concerning characteristics of applications software by inserting the word(s) that best completes each statement.

    a. Applications software is almost always ____________ to performing one specific function

    b. Because most applications software is tied-in to sensor input, no ____________ input is required

TEST

35. Match numbering systems with their structures.

_____a. A numbering system with a base of 10 that uses the digits 0 through 9 to represent all numbers in the system

_____b. A numbering system with a base of 2 that uses only the digits 0 and 1 to represent all numbers in the system

_____c. A numbering system with a base of 16 which uses the digits 0 through 9 to present the numbers 9 through 9 and the letters A through F to represent the numbers 10 through 15

_____d. A numbering system that assigns a four-digit binary code to each digit in a decimal number

_____e. A numbering system with a base of 8 that was (and is) used in some early microcomputers

1. Binary
2. Octal
3. BCD
4. Decimal
5. Hexadecimal

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

36. Convert binary numbers to decimal numbers and decimal numbers to binary numbers. (Assignment Sheet #1)

37. Convert octal numbers to binary and decimal numbers and binary and decimal numbers to octal numbers. (Assignment Sheet #2)

38. Convert hexadecimal numbers to binary and decimal numbers and binary and decimal numbers to hexadecimal numbers. (Assignment Sheet #3)

39. Convert decimal numbers into binary, hexadecimal, and binary coded decimal numbers. (Assignment Sheet #4)

40. Label a pinout for a microprocessor. (Assignment Sheet #5)

MICROCOMPUTER OVERVIEW
UNIT II

ANSWERS TO TEST

1. a. 4
   b. 3
   c. 5
   d. 6
   e. 7
   f. 2
   g. 1

2. a. 5
   b. 2
   c. 10
   d. 3
   e. 8
   f. 9
   g. 1
   h. 4
   i. 7
   j. 6

3. a. 3
   b. 5
   c. 1
   d. 4
   e. 6
   f. 2

4. a. 1) Decodes
      2) Registers
      3) Interrupt
   b. 1) Step-by-step progress
      2) ALU
      3) One
      4) Status, changes
      5) Interrupted

5. a. Address, select
   b. Read/write

6. a,b

7. a. 2
   b. 4
   c. 5
   d. 1
   e. 3

ANSWERS TO TEST

8. a. IC clock circuit
    b. Waveform
    c. Low
    d. On-line
    e. Inoperative
    f. Real time

9. a. 5
    b. 6
    c. 3
    d. 4
    e. 1
    f. 2

10. a. Microprocessor
    b. Memory
    c. Function
    d. I/O
    e. Specialized

11. a. Abbreviations, symbols
    b. Schematic
    c. Quick references

12. a. 4
    b. 2
    c. 1
    d. 5
    e. 3
    f. 6

13. a. Address
    b. Data
    c. Clock out
    d. Reset
    e. Ready
    f. Read/write
    g. Bar
    h. +5V
    i. Ground

14. a. 1
    b. 3
    c. 2
    d. 4

15. a,b,c

16. a,b,c

ANSWERS TO TEST

17. a. Word length
    b. Microprocessors

18. a. Power up
    b. Read, video
    c. Hardware
    d. Knit

19. a. Disk operating system
    b. Nondisk operating system

20. b,c

21. a. 4
    b. 1
    c. 6
    d. 3
    e. 5
    f. 7
    g. 2

22. a. A minor change
    b. That the operating system has undergone a complete change
    c. A first generation DOS

23. a. DOS change
    b. Proper DOS
    c. Register

24. a. 2
    b. 4
    c. 3
    d. 1

25. a. Oxide-coated
    b. Replace a floppy disk of the same size

26. a,c

27. a. Monochrome
    b. Composite color
    c. RGB

28. a. Generators
    b. Clocks
    c. 1) Still running
       2) Being printed
    d. Drafting
    e. 1) Mouse
       2) Light
       3) Tablets
    f. Robotic, phone

ANSWERS TO TEST

29. a. 4
    b. 1
    c. 2
    d. 3

30. a,b,c,d,e

31. a. Memory devices
    b. Abbreviations
    c. Labeling
    d. Assembler
    e. Machine
    f. Machine
    g. Ten

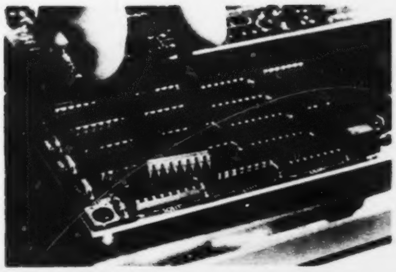
32. a. Easy
    b. Interpreter, compiler
    c. Microprocessor
        1) Built into
        2) Slow
    d. Machine
        1) Purchased as add-ons
        2) Faster

33. a,b

34. a. Dedicated
    b. Operator

35. a. 4
    b. 1
    c. 5
    d. 3
    e. 2

36.-40. Evaluated to the satisfaction of the instructor



SAFETY
UNIT III

UNIT OBJECTIVE

After completion of this unit, the student should be able to discuss electrical safety as it applies to microcomputer repair, and identify dangerous high voltage areas around a microcomputer system. The student should also be able to solve safety problems and discharge high voltage from a CRT. These competencies will be evidenced by correctly completing the procedures outlined in the assignment and job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to safety with their correct definitions.
2. Complete statements concerning general safety.
3. Complete statements concerning basic electrical safety.
4. Arrange in order the steps in safely taking a high voltage reading.
5. Complete a list of ways to control static discharge.
6. Select true statements concerning guidelines for protecting media from magnetic damage.
7. Complete a list of guidelines for handling floppy disks.
8. Complete a list of guidelines for storing floppy disks.
9. Select true statements concerning environmental safety.
10. Complete statements concerning other equipment-related safety guidelines.
11. Complete a list of other items related to personal safety.
12. Solve safety problems. (Assignment Sheet #1)
13. Complete a student safety pledge with parental endorsement. (Assignment Sheet #2)
14. Complete a student safety pledge. (Assignment Sheet #3)
15. Locate first aid and emergency areas. (Assignment Sheet #4)
16. Demonstrate the ability to discharge high voltage from a CRT. (Job Sheet #1)

SAFETY
UNIT III

SUGGESTED ACTIVITIES

A. Provide student with objective sheet.

B. Provide student with information, assignment, and job sheets.

C. Make transparencies.

D. Discuss information sheet.

E. Have the school nurse, a local doctor, or a local Red Cross Instructor talk to the class about first aid and demonstrate first aid procedures that students should know.

F. Invite local fire department personnel to talk to the class about fire safety and the special elements of safety required around electrical fires, and what kind of fire extinguisher should be used on electrical fires.

G. Demonstrate the safe and proper way to bleed high voltages off to ground and physically point out on as many different types of microcomputer systems that you have available, the areas where high voltage hazards are present at the AC input and around the DC video components.

H. Review classroom and lab procedures for reporting a fire, for safely evacuating the building, and for proper reassembly.

I. Review evacuation procedures for a tornado alert and make sure students know the location of the nearest storm cellar.

J. Physically show students where first aid supplies are located, where the nearest fire extinguisher is located and how to use it, where the closest phone is located, and where emergency telephone numbers are posted.

K. Have a floppy disk available to demonstrate how to handle and store floppies, and to discuss floppy nomenclature.

L. Give test.

CONTENTS OF THIS UNIT

A. Objective sheet

B. Information sheet

CONTENTS OF THIS UNIT

C. Transparency masters

   1. TM 1 — Inserting a Floppy Disk
   2. TM 2 — Handling a Floppy Disk
   3. TM 3 — Standard Student Accident Form
   4. TM 4 — Fire Safety

D. Assignment sheets

   1. Assignment Sheet #1 — Solve Safety Problems
   2. Assignment Sheet #2 — Complete a Student Safety Pledge with Parental Endorsement
   3. Assignment Sheet #3 — Complete a Student Safety Pledge
   4. Assignment Sheet #4 — Locate First Aid and Emergency Areas

E. Answers to assignment sheets

F. Job Sheet #1 — Discharge High Voltage From a CRT

G. Test

H. Answers to test

REFERENCES USED IN DEVELOPING THIS UNIT

A. *Kansas Safety Education Handbook, Volume III.* Wichita, KS: Kansas State Department of Education in Cooperation with the Wichita Public Schools, U.S.D. 259, 1981.

B. *Kidde Portable Extinguishers, The ABC's of Fire Prevention.* Belleville, NJ: Walter Kidde & Co., Inc., 1978.

C. The American Red Cross. *Standard First Aid and Personal Safety.* Garden City, NY: Doubleday and Co., Inc., 1978.

SAFETY
UNIT III

INFORMATION SHEET

I. **Terms and definitions**

A. AC — Alternating current

B. DC — Direct current

C. Media — Devices such as floppy disks, hard disks, and tapes of various kinds that are used to record and store electronic information

D. Static electricity — Electrical charges in the atmosphere that can be transmitted and discharged by any friction-producing body (especially a human body) in the immediate environment

E. Warranty — A written statement outlining the manufacturer's responsibilities for maintenance and/or repair of a product under certain conditions for a given period of time

F. CRT — Cathode ray tube, the television-like screen built into a computer or used as an add-on video display

II. **General safety**

A. Respect all school or company safety rules

B. Use all tools and equipment for their intended purposes only

C. Use testing tools and testing equipment only after you have been instructed in their proper uses and have been authorized to use them by your instructor

D. Horseplay around electronic equipment is extremely dangerous and strictly forbidden

E. Rings, necklaces, and any metallic jewelry that might inadvertently come in contact with high voltage areas of a computer system should be removed before entering the work area

F. Always ask questions when in doubt, and never experiment with test equipment or customer property

G. Remember that the potential for personal injury is minimal in the computer repair industry, but the potential for damaging an expensive piece of equipment is ever present

INFORMATION SHEET

III. **Basic electrical safety**

A. Electrical hazards around computer repair facilities are limited but still present, and attention and common sense are the best tools for promoting electrical safety

B. Potentially hazardous high voltages are present in certain areas of a microcomputer system, and these demand special attention:

1. High voltage AC at the input of the computer

2. High voltage DC around the video display unit and especially around the CRT

C. When repair work requires opening a microcomputer case, and especially when repairs require work around the video display unit, always unplug the system at least one hour in advance to allow high voltages to bleed off, or discharge the high voltage to ground as outlined in Job Sheet #1

D. Avoid inadvertent damage to system components by attaching leads in safe order and by using probes with care

(NOTE: See Objective IV.)

E. Never disable 3-prong grounding devices on equipment being repaired or test equipment being used

F. Never extract or insert printed circuit modules with the power on

G. Respect static electricity and electrostatic discharge as a major problem around computer systems and media, and follow all rules related to static discharge control

H. Respect all kinds of media as being subject to static damage, and also subject to magnetic damage from certain devices too close to the work area

IV. **Steps in safely taking a high voltage reading**

A. Turn the power OFF to the system under test

B. Wait for about two minutes, but use the time to set the correct range and polarity on the DVOM or to set the high voltage probe

C. Connect the ground lead of the test instrument first

D. Connect the positive lead of the test instrument last

E. Turn the power ON, but do not touch the test meter or the leads

INFORMATION SHEET

F. Read the test instrument

G. Turn the power OFF

H. Record the reading before you forget it

I. Disconnect both leads

(**CAUTION:** This is a safe procedure, but do not practice it until you have been personally instructed by your instructor, and do not use it without permission from your instructor.)

V. **Ways to control static discharge**

A. Be sure that humidity controls in the repair facility are working and properly set

B. Use static mats when possible

C. Develop the habit of grounding yourself by touching a grounded component before working with a system

D. Be careful not to dry out the atmosphere in cold weather by setting temperature controls too high

(NOTE: Static electricity is normally a bigger problem in cold weather, and winter months may demand extra attention to static discharge control.)

E. Handle parts that are contained in static-protected packages with special care and install them only in a static-free environment

(NOTE: Static-protection packages are usually so marked or so colored that they're difficult to miss, and the procedure for protecting these parts during installation is covered in a later troubleshooting routine.)

F. Be especially careful of static discharge when handling floppies that contain software or important data, and always ground yourself to another safe part of the system before handling the media

VI. **Guidelines for protecting media from magnetic damage**

A. The entire microcomputer work area should be kept free of magnetic fields that can erase or damage data on floppy or hard disks

B. Items that should be kept away from the immediate work area include:

1. Telephone
2. Paper clips, scissors, or any tools that have been magnetized

INFORMATION SHEET

3. Radios and tape player speakers

4. Magnetized board markers or magnetic board games

5. Magnetized latching devices on storage cabinets

(NOTE: These should be kept away from the work area, but there is potential for lost data even when floppies are stored in cabinets with magnetized latches.)

C. To guard against unexpected loss, always make backup copies of important software or important data

D. Remember that a hard disk is subject to the same damages as other media, and that hard disk drives are extremely expensive pieces of equipment and should be handled with care at all times

VII. **Guidelines for handling floppy disks** (Transparencies 1 and 2)

A. Permit cold floppies to warm to room temperature before using

B. Always insert floppies correctly into a drive and never attempt to remove a floppy when the drive's red light is still on

C. Never put paper clips on floppies and never place rubber bands around floppies

D. Do not squeeze floppies or try to bend them, and do not throw them about

E. Never touch the exposed read/write surface of a floppy because a fingerprint can destroy data

F. Label floppies carefully with a felt-tip pen, not a ball-point

VIII. **Guidelines for storing floppy disks**

A. When a floppy is not in a disk drive, it belongs in its protective jacket

B. Never permit floppies to lie around on desk tops and never stack books or place heavy objects on top of floppies

C. Store floppy disks upright, not flat

D. Do not store floppies where they will be subjected to excessive cold, heat or direct sunlight

(NOTE: Excessive heat can warp a floppy so that the read/write head will not track properly on it, and excessive cold will cause the floppy to contract and also produce tracking problems.)

INFORMATION SHEET

IX. Environmental safety

A. Just like the environment in which a computer is used, the environment in which a computer is repaired should be as clean as possible, have a comfortable temperature year round, and have enough relative humidity to help control static discharge

B. Smoking around a work bench or in a repair area where computers and peripherals, especially disk drives, are present is strictly a no-no

C. To avoid exposing computer equipment to spills from coffee, coke, or other refreshments, keep all liquid refreshment out of the work area

D. Keep buttered and salted snacks out of the work area too because potato chips and snacks leave grease on finger tips in quantity enough to damage software

E. Use common sense when cleaning in the work environment and don't sweep with a broom that could stir up dust, rather, use a vacuum cleaner

X. Other equipment-related safety guidelines

A. Never work on a microcomputer or peripheral until you know that what you plan to do needs to be done and that doing it will not void a warranty

B. Follow logical, proven troubleshooting routines so you will avoid the prospects of inadvertently creating a bigger problem than the one you started with

C. Never use testing tools or equipment suspected of being faulty, and report such equipment to the proper authority

D. Use only lubricants recommended by the manufacturer

E. Always remember, it is better to ask a dumb question than to make a dumb mistake

XI. Other items related to personal safety

A. Wear safety glasses when soldering or as school requires

B. Report all accidents, no matter how minor, to your instructor or to a proper authority (Transparency 3)

C. Know the location of the nearest fire extinguisher and how to use it (Transparency 4)

(**CAUTION:** Fire extinguishers used on electrical equipment of any kind should be Class C extinguishers which are loaded with chemicals designed to safely fight electrical fires, and using an extinguisher designed for another class of fire could be dangerous.)

INFORMATION SHEET

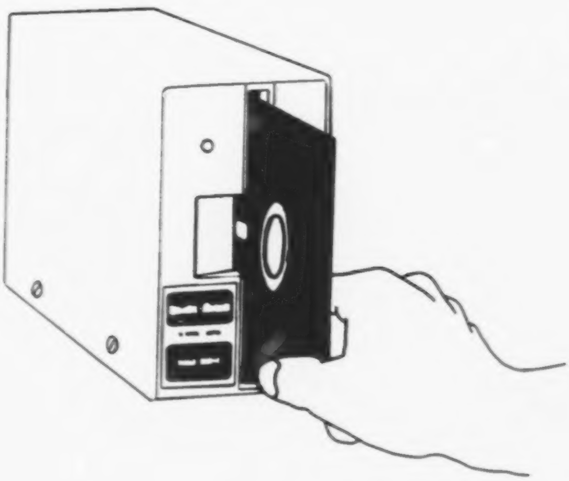
D. Know the location of the nearest fire exit, any alternate fire exits, and reassembly points in case of fire

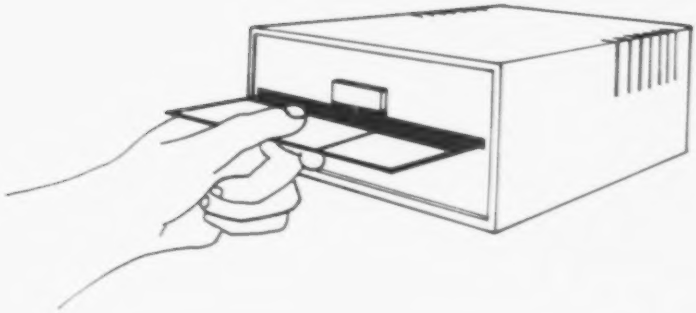
E. Know the emergency evacuation routine for a tornado alert and the location of the nearest storm shelter

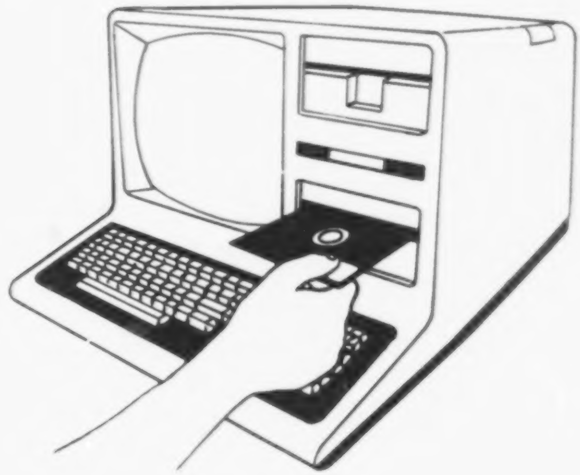
F. Know the location of the nearest telephone and where emergency numbers can quickly be found

G. Know where first aid supplies are located

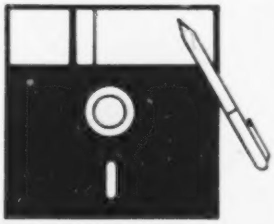
Inserting a Floppy Disk



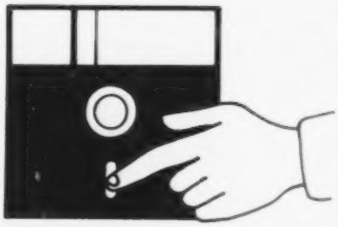




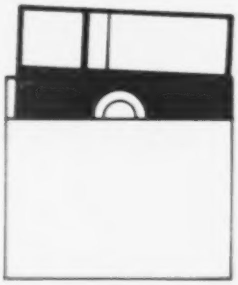
Handling a Floppy Disk



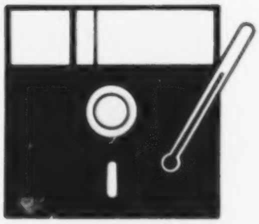
Use only felt tip pen on jacket



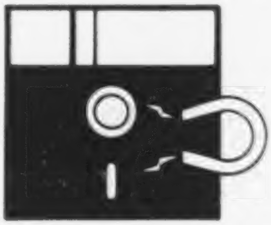
Never touch disk



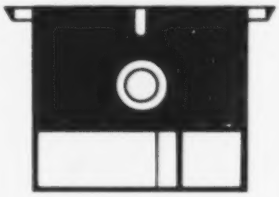
Protect in envelope



Maintain temperature of 50°F to 125°F



Never expose to magnetic field



Insert carefully

Do not bend or fold

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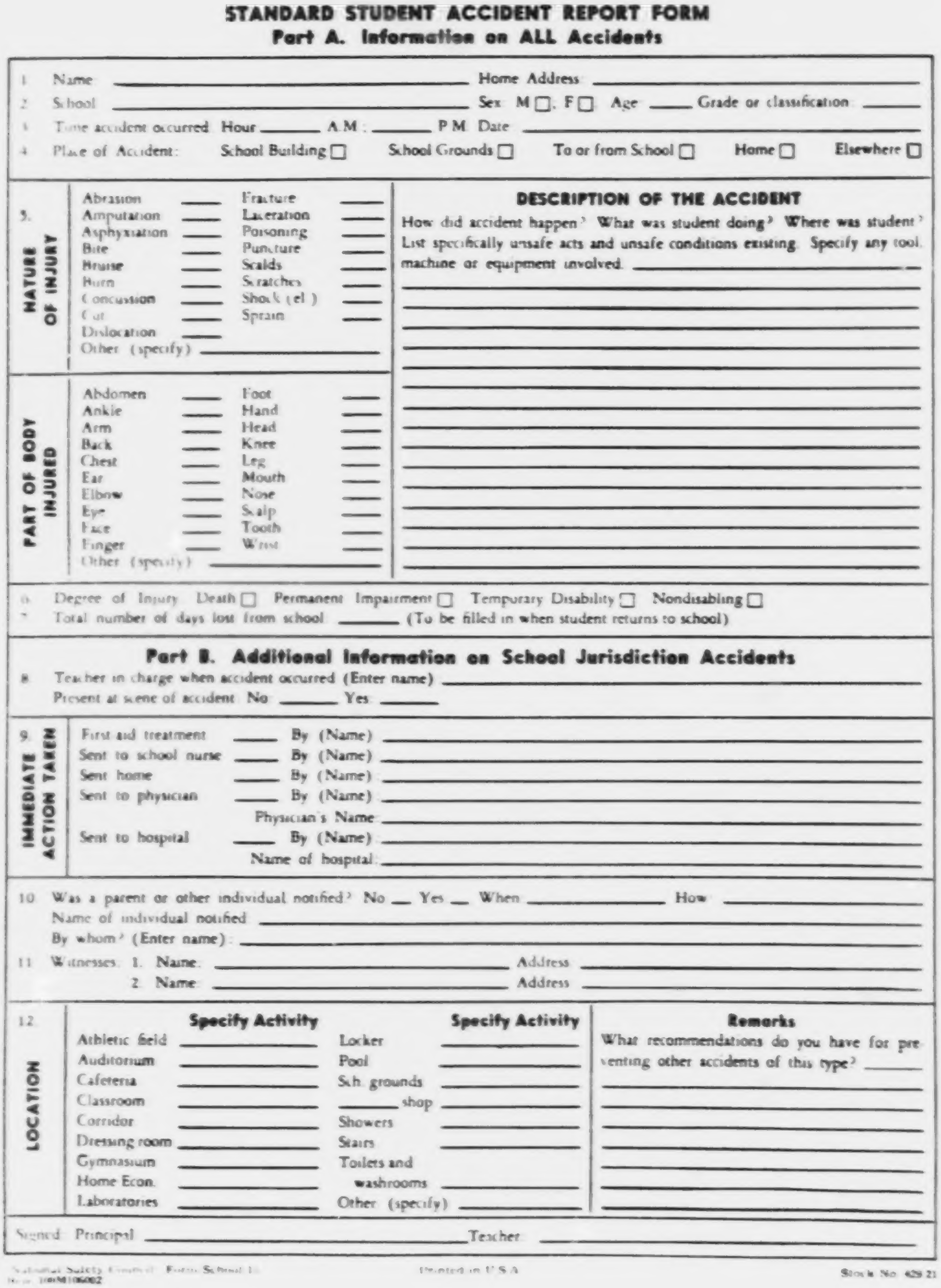
Standard Student Accident Form



STANDARD STUDENT ACCIDENT REPORT FORM

Part A. Information on ALL Accidents

1. Name ____________ Home Address ____________
2. School ____________ Sex M ☐, F ☐ Age ____ Grade or classification ____
3. Time accident occurred Hour ____ A.M.: ____ P.M. Date ____________
4. Place of Accident: School Building ☐ School Grounds ☐ To or from School ☐ Home ☐ Elsewhere ☐

5. **NATURE OF INJURY**

Abrasion ____
Amputation ____
Asphyxiation ____
Bite ____
Bruise ____
Burn ____
Concussion ____
Cut ____
Dislocation ____
Fracture ____
Laceration ____
Poisoning ____
Puncture ____
Scalds ____
Scratches ____
Shock (el.) ____
Sprain ____
Other (specify) ____________

PART OF BODY INJURED

Abdomen ____
Ankle ____
Arm ____
Back ____
Chest ____
Ear ____
Elbow ____
Eye ____
Face ____
Finger ____
Foot ____
Hand ____
Head ____
Knee ____
Leg ____
Mouth ____
Nose ____
Scalp ____
Tooth ____
Wrist ____
Other (specify) ____________

DESCRIPTION OF THE ACCIDENT

How did accident happen? What was student doing? Where was student? List specifically unsafe acts and unsafe conditions existing. Specify any tool, machine or equipment involved. ____________

6. Degree of Injury Death ☐ Permanent Impairment ☐ Temporary Disability ☐ Nondisabling ☐
7. Total number of days lost from school ____ (To be filled in when student returns to school)

Part B. Additional Information on School Jurisdiction Accidents

8. Teacher in charge when accident occurred (Enter name) ____________
Present at scene of accident No ____ Yes ____

9. **IMMEDIATE ACTION TAKEN**

First aid treatment ____ By (Name) ____________
Sent to school nurse ____ By (Name) ____________
Sent home ____ By (Name) ____________
Sent to physician ____ By (Name) ____________
Physician's Name ____________
Sent to hospital ____ By (Name) ____________
Name of hospital ____________

10. Was a parent or other individual notified? No __ Yes __ When ____________ How ____________
Name of individual notified ____________
By whom? (Enter name) ____________
11. Witnesses: 1. Name ____________ Address ____________
2. Name ____________ Address ____________

12. **LOCATION**

Specify Activity

Athletic field ____________
Auditorium ____________
Cafeteria ____________
Classroom ____________
Corridor ____________
Dressing room ____________
Gymnasium ____________
Home Econ. ____________
Laboratories ____________

Specify Activity

Locker ____________
Pool ____________
Sch. grounds ____________
____ shop ____________
Showers ____________
Stairs ____________
Toilets and washrooms ____________
Other (specify) ____________

Remarks

What recommendations do you have for preventing other accidents of this type? ____________

Signed: Principal ____________ Teacher ____________

National Safety Council Form School 1a
Rev. 1008106002

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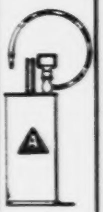
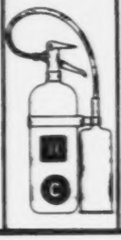
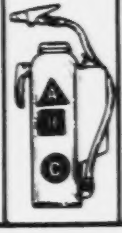
Stock No. 429.21

TM 3

Fire Safety

KIND OF FIRE		APPROVED TYPE OF EXTINGUISHER						
DECIDE THE CLASS OF FIRE YOU ARE FIGHTING. . . ↓	. . .THEN CHECK THE COLUMNS TO THE RIGHT OF THAT CLASS →	MATCH UP PROPER EXTINGUISHER WITH CLASS OF FIRE SHOWN AT LEFT						
		FOAM Solution of Aluminum Sulphate and Bicarbonate of Soda	**CARBON DIOXIDE** Carbon Dioxide Gas Under Pressure	**SODA ACID** Bicarbonate of Soda Solution and Sulphuric Acid	**PUMP TANK** Plain Water	**GAS CARTRIDGE** Water Expelled by Carbon Dioxide Gas	**MULTI-PURPOSE DRY CHEMICAL**	**ORDINARY DRY CHEMICAL**
A 	**CLASS A FIRES** USE THESE EXTINGUISHERS → ORDINARY COMBUSTIBLES • WOOD • PAPER • CLOTH ETC.		X					X
B 	**CLASS B FIRES** USE THESE EXTINGUISHERS → FLAMMABLE LIQUIDS, GREASE • GASOLINE • PAINTS • OILS, ETC.			X	X	X		
C 	**CLASS C FIRES** USE THESE EXTINGUISHERS → ELECTRICAL EQUIPMENT • MOTORS • SWITCHES ETC.	X		X	X	X		

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SAFETY
UNIT III

ASSIGNMENT SHEET #1 — SOLVE SAFETY PROBLEMS

Directions: Some of the following questions can be answered directly and others may require more than one answer, so read the questions carefully and make your answer complete.

A. A fellow student smokes a cigarette near a work bench where a disc drive is being repaired. Is there a problem? If so, what should be done to correct the problem?

Answer: ____

____

B. Where is the location of the nearest fire extinguisher from the point where you are right now?

Answer: ____

____

C. In the event of a real fire in your training facility, what reassembly point would you go to?

Answer: ____

D. A fellow student unplugs a microcomputer and begins immediately to open the case. Is there a problem? If so, what should be done to correct it?

Answer: ____

E. After lunch, a fellow student brings part of a box of popcorn back to the computer repair area, finishes it off, and then starts troubleshooting a disc drive. Is there a problem? If so, what should be done to correct it?

Answer: ____

F. A fellow student begins to desolder connections to a keyboard and is not wearing safety glasses. Is there a problem? If so, what should be done to correct it?

Answer: ____

G. Where is the location of the nearest telephone from the point where you are right now?

Answer: ____

ASSIGNMENT SHEET #1

H. What telephone number would you call in the event a fire occurred in the computer repair area?

Answer: ______________________________

I. If you needed first aid supplies, where would you get them?

Answer: ______________________________

J. A fellow student has left a floppy disk lying flat and uncovered near a disk drive she is checking. Is there a problem? If so, what should be done to correct it?

Answer: ______________________________

K. A fellow student starts to remove a video driver card from a microcomputer while the system is obviously still turned on. Is there a problem? If so, what should be done to correct it?

Answer: ______________________________

L. It is warm and humid in the work area. Is the potential for static electricity problems high?

Answer: ______________________________

M. It is cool and dry in the work area. Is the potential for static electricity problems high?

Answer: ______________________________

N. A fellow student accidentally punctures a finger when a screwdriver slips, but he washes the wound and puts a band aid on it immediately and feels it is just a minor incident that shouldn't concern anybody but himself. Is there a problem? If so, what should be done to correct it?

Answer: ______________________________

O. A student cleaning up the work area is sweeping with a broom and it is evident that it is creating dust in the work area. Is there a problem? If so, what should be done to correct it?

Answer: ______________________________

P. Where are high voltage dangers most hazardous around a microcomputer system?

Answer: ______________________________

SAFETY
UNIT III

ASSIGNMENT SHEET #2 — COMPLETE A STUDENT SAFETY PLEDGE WITH PARENTAL ENDORSEMENT

STUDENT SAFETY PLEDGE FOR MICROCOMPUTER REPAIR

_________________________, who is enrolled in microcomputer repair studies at _________________________, will, as part of the training program, operate microcomputers and peripherals, test tools, and testing equipment. These activities require the written permission of parent(s) or guardian(s).

It is understood that the student will be given proper instruction for the use of all equipment before being allowed to use the equipment alone. It is further understood that the student will be instructed in safety requirements for the school in general and for activities in the computer repair work area. In turn, the student is expected to conduct herself/himself in a safe manner, and to indicate an awareness of that responsibility by signing the following student safety pledge.

I promise to abide by all safety rules for the school and for the computer repair area as follows:

A. To use tools or test equipment only after proper instruction and only with the instructor's permission

B. To use tools and test equipment only for their intended purposes and to wear safety glasses when shop activities present any form of eye hazard

C. To appreciate the special need for cleanliness in the computer repair area and to not smoke in that area or carry liquid refreshments into that area

D. To avoid horseplay at all times

E. To share in housekeeping responsibilities and to conduct myself in a safe manner on school property

Date _________________ Student's Signature _________________________________

As parent(s) or guardian(s) of _____________________, I (We) hereby give consent for the student to use tools and test equipment as needed to complete requirements for the computer repair course in which he/she is currently enrolled.

Date _________________

Parent(s) or guardian(s) signature(s) ____

____

(NOTE: Parents and guardians are invited to visit the school and inspect the computer repair program at any convenient time.)

SAFETY
UNIT III

ASSIGNMENT SHEET #3 — COMPLETE A STUDENT SAFETY PLEDGE

I understand that I will be given proper instruction for the use of all equipment before being allowed to use the equipment alone. I further understand that I will be instructed in safety requirements for the school in general and for activities in the computer repair work area. In turn, I know that I shall be expected to conduct myself in a safe manner, and to indicate an awareness of that responsibility, I make the following safety pledge.

I promise to abide by all safety rules for the school and for the computer repair area as follows:

A. To use tools and test equipment only after proper instruction and only with the instructor's permission

B. To use tools and test equipment only for their intended purposes and to wear safety glasses when shop activities present any form of eye hazard

C. To appreciate the special need for cleanliness in the computer repair area and to not smoke in that area or to carry liquid refreshments into that area

D. To avoid horseplay at all times

E. To share in housekeeping responsibilities and to conduct myself in a safe manner on school property

Date ________________ Student's Signature ___________________________________

SAFETY
UNIT III

ASSIGNMENT SHEET #4 — LOCATE FIRST AID AND EMERGENCY AREAS

Directions: Answer the following questions with respect to the laboratory or classroom where you are at this moment?

A. Where is the nearest telephone?

Answer ______________________________

B. What number would you call in the event of fire?

Answer ______________________________

C. Where is the nearest fire exit?

Answer ______________________________

D. Where are the nearest first aid supplies located?

Answer ______________________________

E. Where is the reassembly point you would go to in the event of a fire drill or an emergency evacuation?

Answer ______________________________

F. Where is the nearest storm shelter?

Answer ______________________________

G. What kind of signal would you expect for a tornado emergency?

Answer ______________________________

SAFETY
UNIT III

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

A. Yes. Quit smoking because smoking is not permitted in a computer repair area.

B. Evaluated by the instructor

C. Evaluated by the instructor

D. Yes. Allow enough time for high voltage to drain down or discharge the high voltage to ground.

E. Yes. Butter and salt on popcorn leave grease on finger tips, and snacks should not be taken into the repair area.

F. Yes. Solder can splatter erratically at times and safety glasses should always be worn when soldering.

G. Evaluated by the instructor

H. Evaluated by the instructor

I. Evaluated by the instructor

J. Yes. Floppy disks should be placed in protective jackets and stored upright.

K. Yes. Turn the system off because printed circuit cards should never be removed or replaced while the power is on.

L. No.

M. Yes.

N. Yes. Report the accident to your instructor because all accidents, no matter how minor, should be reported.

O. Yes. Use a vacuum cleaner because a broom stirs up dust that can cause damage to system parts, disk drives, and floppies.

P. At the AC input line, around the video display, and especially around the CRT.

Assignment Sheets #2 and #3 should be retained and filed or otherwise handled according to school policy, and Assignment Sheet #4 should be evaluated to the satisfaction of the instructor.

SAFETY
UNIT III

JOB SHEET #1 — DISCHARGE HIGH VOLTAGE FROM A CRT

A. Tools and equipment

1. Monitor as selected by instructor
2. OEM schematic or Computerfacts™ for selected monitor
3. Hand tools for disassembly and reassembly
4. Screwdriver with well insulated handle
5. Clip lead with a clip on each end

B. Procedure

(**CAUTION:** This procedure should be executed only in the presence of your instructor, and no future attempt to discharge high voltage from a CRT should be made without your instructor's permission.)

1. Make sure the monitor has been plugged in recently enough to charge the high voltage section of the CRT
2. Make sure the monitor is unplugged from the host computer and from its power source
3. Follow OEM instructions for removing the monitor case and be sure to save every screw which you remove
4. Remove the monitor case carefully and set it aside at a safe distance

   (NOTE: Keep the work area clear of anything that could cut or scrape your hands — you'll see why in a minute.)

5. Clip one end of the clip lead onto the metal chassis of the monitor
6. Clip the other end of the clip lead to the metal shaft of the screwdriver
7. Locate the spot where the high voltage lead makes contact with the anode of the CRT

   (NOTE: This point should be easy to find, especially with the help of a good schematic, because the high voltage lead is usually larger than any other wires and usually has an insulated cover, but be sure to ask your instructor if you're in doubt.)

JOB SHEET #1

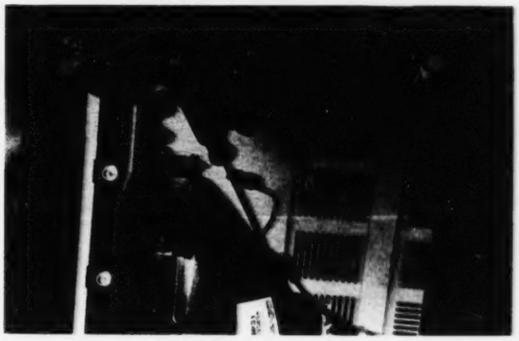
8. BRACE YOURSELF FOR A LOUD POPPING SOUND, and if the contact point of the high voltage lead and the anode is not insulated, THERE WILL BE A BRIGHT ARC

   (**CAUTION:** The sound and the arc inspire response that can cause you to jerk your hand back quickly, so that's why the work area should be free of anything that could cut or scrape a hand or arm.)

9. Doublecheck to make sure all power is unplugged

10. Hold the insulated part of the screwdriver handle, then slip the screwdriver blade under the insulated cover so that it makes contact with the high voltage/anode connection (Figure 1)

    FIGURE 1



11. Remove the blade as soon as the loud pop has ended

    ☐ Have your instructor check your work

12. Replace the monitor case, and clean up area and return tools and equipment to proper storage

SAFETY
UNIT III

NAME ______________________

TEST

1. Match the terms on the right with their correct definitions.

______a. Alternating current

______b. Direct current

______c. Devices such as floppy disks, hard disks, and tapes of various kinds that are used to record and store electronic information

______d. Electrical charges in the atmosphere that can be transmitted and discharged by any friction-producing body (especially a human body) in the immediate environment

______e. A written statement outlining the manufacturer's responsibilities for maintenance and/or repair of a product under certain conditions for a given period of time

______f. Cathode ray tube, the television-like screen built into a computer or used as an add-on video display

1. CRT
2. Warranty
3. AC
4. Static electricity
5. DC
6. Media

2. Complete the following statements concerning general safety by inserting the word(s) that best completes each statement.

a. Respect all ____________ or ____________ safety rules

b. Use all ____________ and ____________ for their intended purposes only

c. Use ____________ tools and ____________ equipment only after you have been instructed in their proper uses and have been authorized to use them by your instructor

d. ____________ around electronic equipment is extremely dangerous and strictly forbidden

e. Rings, necklaces, and any metallic jewelry that might inadvertently come in contact with high voltage areas of a computer system should be ____________ before entering the work area

TEST

f. Always ask questions when in doubt, and never __________ with test equipment or customer property

g. Remember that the potential for personal injury is __________ in the computer repair industry, but the potential for damaging an expensive piece of equipment is ever present

3. Complete the following statements concerning basic electrical safety by inserting the word(s) that best completes each statement.

a. Electrical hazards around computer repair facilities are limited but still present, and __________ and common sense are the best tools for promoting electrical safety

b. Potentially hazardous high voltages are present in certain areas of a microcomputer system, and these demand special attention:

1) High voltage __________ at the __________ of the computer

2) High voltage __________ around the video display unit and especially around the __________

c. When repair work requires opening a microcomputer case, and especially when repairs require work around the video display unit, always unplug the system at least __________ __________ __________ __________ to allow high voltages to bleed off, or discharge the high voltage to ground

d. Avoid inadvertent damage to system components by attaching __________ in safe order and by using __________ with care

e. Never disable __________-__________ grounding devices on equipment being repaired or test equipment being used

f. Never extract or insert printed circuit modules with the __________ __________

g. Respect static electricity and electrostatic discharge as a __________ problem around computer systems and media, and follow all rules related to static discharge control

h. Respect all kinds of __________ as being subject to static damage, and also subject to magnetic damage from certain devices too close to the work area

4. Arrange in order the steps in safely taking a high voltage reading by placing the correct sequence number in the appropriate blank.

______a. Turn the power ON, but do not touch the test meter or the leads

______b. Turn the power OFF

TEST

______c. Disconnect both leads

______d. Connect the positive lead of the test instrument last

______e. Record the reading before you forget it

______f. Connect the ground lead of the test instrument first

______g. Read the test instrument

______h. Wait for about two minutes, but use the time to set the correct range and polarity on the DVOM or to set the high voltage probe

______i. Turn the power OFF to the system under test

5. Complete the following list of ways to control static discharge by inserting the word(s) that best completes each statement.

   a. Be sure that ____________ controls in the repair facility are working and properly set

   b. Use ____________ mats when possible

   c. Develop the habit of grounding yourself by touching a ____________ component before working with a system

   d. Be careful not to dry out the atmosphere in cold weather by setting temperature controls too ____________

   e. Handle parts that are contained in ____________ ____________ packages with special care and install them only in a static-free environment

   f. Be especially careful of static discharge when handling ____________ that contain software or important data, and always ground yourself to another safe part of the system before handling the media

6. Select true statements concerning guidelines for protecting media from magnetic damage by placing an "X" in the appropriate blanks.

   (NOTE: For a statement to be true, all parts of the statement must be true.)

   ______a. The entire microcomputer work area should be kept free of magnetic fields that can erase or damage data on floppy or hard disks

TEST

______b. Items that should be kept away from the immediate work area include:

1) Telephone
2) Paper clips, scissors, or any tools that have been magnetized
3) Radios and tape player speakers
4) Magnetized board markers or magnetic board games
5) Magnetized latching devices on storage cabinets

______c. To guard against unexpected loss, it is sometimes best to make backup copies of important software or important data

______d. Remember that a hard disk is subject to the same damages as other media, and that hard disk drives are extremely expensive pieces of equipment and should be handled with care at all times

7. Complete the following list of guidelines for handling floppy disks by inserting the word(s) that best completes each statement.

a. Permit cold floppies to warm to ____________ ____________ before using

b. Always ____________ floppies correctly into a drive and never attempt to ____________ a floppy when the drive's red light is still on

c. Never put ____________ ____________ on floppies and never place ____________ ____________ around floppies

d. Do not squeeze floppies or try to ____________ them, and do not throw them about

e. Never touch the exposed read/write surface of a floppy because a ____________ can destroy data

f. Label floppies carefully with a ____________ ____________ pen, not a ballpoint

8. Complete the following list of guidelines for storing floppy disks by inserting the word(s) that best completes each statement.

a. When a floppy is not in a disk drive, it belongs in ____________ ____________ ____________

b. Never permit floppies to ____________ ____________ on desk tops and never stack books or place heavy objects on top of floppies

c. Store floppy disks ____________, not flat

d. Do not store floppies where they will be subjected to excessive cold, heat, or ____________ ____________

TEST

9. Select true statements concerning environmental safety by placing an "X" in the appropriate blanks.

_____a. Just like the environment in which a computer is used, the environment in which a computer is repaired should be as clean as possible, have a comfortable temperature year round, and have enough relative humidity to help control static discharge

_____b. Smoking around a work bench, or in a repair area where computers and peripherals, especially disk drives, are present is usually okay

_____c. To avoid exposing computer equipment to spills from coffee, coke, or other refreshments, keep all liquid refreshments out of the work area

_____d. Keep buttered and salted snacks out of the work area too because potato chips and snacks leave grease on finger tips in quantity enough to damage software

_____e. Use common sense when cleaning in the work environment and sweep with a broom to be sure you really get the place clean

10. Complete the following statements concerning other equipment-related safety guidelines by inserting the word(s) that best completes each statement.

a. Never work on a microcomputer or peripheral until you know that what you plan to do needs to be done and that doing it will not _____________ _____________ _____________

b. Follow logical, proven troubleshooting routines so you will avoid the prospects of inadvertently creating a _____________ _____________ than the one you started with

c. Never use testing tools or equipment suspected of being _____________, and report such equipment to the proper authority

d. Use only _____________ recommended by the manufacturer

e. Always remember, it is better to ask a _____________ _____________ than to make a _____________ _____________

11. Complete the following list of other items related to personal safety by inserting the word(s) that best complete each statement.

a. Wear safety glasses when _____________ or as school requires

b. Report _____________ accidents, no matter how minor, to your instructor or to a proper authority

c. Know the location of the nearest _____________ _____________ and how to use it

d. Know the location of the nearest _____________ _____________, any alternate fire exits, and reassembly points in case of fire

TEST

e. Know the emergency evacuation routine for a tornado alert and the location of the nearest ____________ ____________

f. Know the location of the nearest ____________ and where emergency numbers can quickly be found

g. Know where ____________ ____________ supplies are located

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

12. Solve safety problems. (Assignment Sheet #1)

13. Complete a student safety pledge with parental endorsement. (Assignment Sheet #2)

14. Complete a student safety pledge. (Assignment Sheet #3)

15. Locate first aid and emergency areas. (Assignment Sheet #4)

16. Demonstrate the ability to discharge high voltage from a CRT. (Job Sheet #1)

SAFETY
UNIT III

ANSWERS TO TEST

1. a. 3
   b. 5
   c. 6
   d. 4
   e. 2
   f. 1

2. a. School, company
   b. Tools, equipment
   c. Testing, testing
   d. Horseplay
   e. Removed
   f. Experiment
   g. Minimal

3. a. Attention
   b. 1) AC, input
      2) DC, CRT
   c. One hour in advance
   d. Leads, probes
   e. 3-prong
   f. Power on
   g. Major
   h. Media

4. a. 5
   b. 7
   c. 9
   d. 4
   e. 8
   f. 3
   g. 6
   h. 2
   i. 1

5. a. Humidity
   b. Static
   c. Grounded
   d. High
   e. Static-protected
   f. Floppies

6. a,b,d

ANSWERS TO TEST

7. a. Room temperature
   b. Insert, remove
   c. Paper clips, rubber bands
   d. Bend
   e. Fingerprint
   f. Felt-tip

8. a. Its protective jacket
   b. Lie around
   c. Upright
   d. Direct sunlight

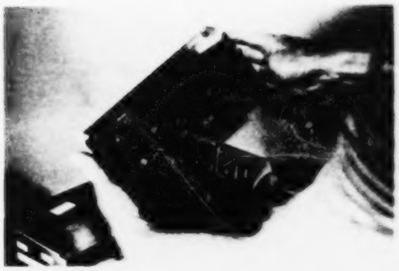
9. a,c,d

10. a. Void a warranty
    b. Bigger problem
    c. Faulty
    d. Lubricants
    e. Dumb question, dumb mistake

11. a. Soldering
    b. All
    c. Fire extinguisher
    d. Fire exit
    e. Storm shelter
    f. Telephone
    g. First aid

12.-15. Evaluated to the satisfaction of the instructor

16. Evaluated according to student status



ASSEMBLY AND START UP PROCEDURES
UNIT IV

UNIT OBJECTIVE

After completion of this unit, the student should be able to unpack a microcomputer, handle static-protected components properly, and assemble a microcomputer. The student should also be able to properly attach a video display, a disk drive, and a printer to complete a microcomputer system, and operate the system to observe the interaction of hardware and software. These competencies will be evidenced by correctly performing the procedures outlined in the job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to assembly and start up procedures with their correct definitions.
2. Arrange in order the steps in unpacking a microcomputer.
3. List components required for system hookup.
4. Complete statements concerning guidelines for internal system hookup.
5. Select true statements concerning guidelines for completing system hookup.
6. Complete statements concerning guidelines for hooking up disk drives.
7. Select true statements concerning guidelines for hooking up printers and modems.
8. Distinguish between microcomputer keyboards.
9. Match other important keys with their functions.
10. Complete statements concerning power on/off and initialization routines.
11. Complete statements concerning operating manuals.
12. List ways proper setup procedures help eliminate future problems.
13. Demonstrate the ability to:
    a. Hook up a microcomputer system. (Job Sheet #1)
    b. Operate a microcomputer system to observe interaction of system components. (Job Sheet #2)

ASSEMBLY AND START UP PROCEDURES
UNIT IV

SUGGESTED ACTIVITIES

A. Provide student with objective sheet.

B. Provide student with information and job sheets.

C. Discuss unit and specific objectives.

D. Discuss and demonstrate the procedures outlined in the job sheets.

E. Demonstrate to the students the proper way to handle a printed circuit board and impress upon them the importance of developing the habit of handling all cards and boards carefully by the edges, and the requirement for not handling boards any more than they must be handled.

F. Invite a local computer repair technician to talk to the class about the importance of proper microcomputer unpacking, setting up, and the inital record keeping that should be part of the sales procedure. Ask the technician to bring a case history, if possible, to show how initial activities at the point of sale can help with later service needs.

G. Discuss and demonstrate the importance of checking switch settings on cards and boards at the time of system hookup.

H. Give test.

CONTENTS OF THIS UNIT

A. Objective sheet

B. Information sheet

C. Job sheets

   1. Job Sheet #1 — Hook Up a Microcomputer System

   2. Job Sheet #2 — Operate a Microcomputer System to Observe Interaction of System Components

D. Test

E. Answers to test

REFERENCES USED IN DEVELOPING THIS UNIT

A. Stephenson, John, and Bob Cahill. *How to Maintain and Service Your Small Computer.* Indianapolis, IN 46268: Howard W. Sams & Co., Inc., 1983.

B. Drischoll, Frederick F. *Microprocessor-Microcomputer Technology.* North Scituate, MA 02060: Breton Publishers, a division of Wadsworth, Inc., 1983.

C. Tocci, Ronald J., and Lester P. Laskowski. *Microprocessors and Microcomputers.* Englewood Cliffs, NJ 07632: Prentice-Hall, Inc., 1979.

ASSEMBLY AND START UP PROCEDURES
UNIT IV

INFORMATION SHEET

I. **Terms and definitions**

   A. Backup — A copy made of any form of software or program information that would be difficult or expensive to replace if it were lost or damaged

   B. Boot — The process of getting a computer ready to perform programming operations, and is sometimes called booting up, loading, or initializing

   C. Card — A shortened reference to a printed circuit board

   D. Card slots — Connectors built into a system bus for the specific purpose of accepting printed circuit boards designed to drive peripherals or enhance system capacity or performance

   E. Cursor — A character on a display screen used to indicate position, and it may be underlined or appear as a graphics block

   F. DOS — Disk operating system, the software required to boot a system up

II. **Steps in unpacking a microcomputer**

   A. Check the box or crate the computer was shipped in to make sure that there is no evident exterior shipping damage that might have damaged the contents

   (NOTE: This check should be made at the time the computer is delivered from the shipper, but it's always good practice to make the check again immediately prior to unpacking the computer.)

   B. Remove and save any shipping documents or other materials attached to the shipping box (Figure 1)

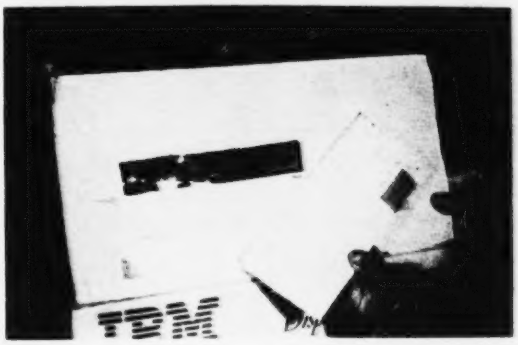
   C. Set the box upright (the box will probably have arrows indicating "this side up") so that the components can be unpacked in the opposite order they were packed (Figure 1)

   D. Open the box carefully and be sure the knife or opener does not penetrate sealing tape far enough to damage contents

INFORMATION SHEET

E. Remove the document package(s) inside the box and find the sheet or document that outlines the assembly procedure and system hookup procedure (Figure 1)

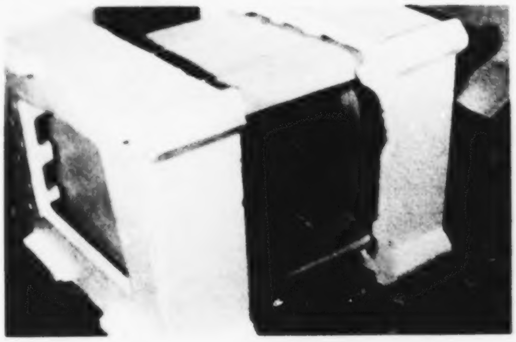
FIGURE 1



F. Remove components carefully and place them onto a clean work area (Figure 2)

(CAUTION: Watch for components packed in static-protecting bags which may be black, light pink, or a smokey-silver color because these components have to be handled so that the electrical connectors or leads on the components are not touched.)

FIGURE 2

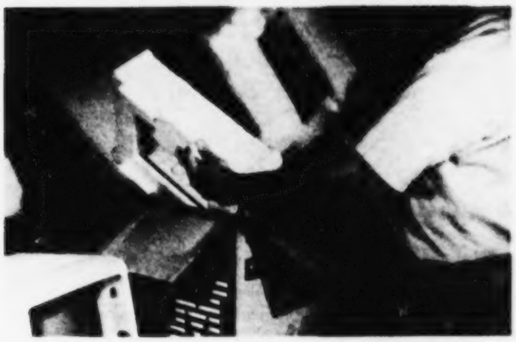


INFORMATION SHEET

G. Return all packing material, especially any contoured styrofoam around individual components, to the shipping box and save the box (Figure 3)

(CAUTION: This is an extremely important part of the procedure because the box and the packing materials should be given to the customer who purchases the computer so the computer can be safely repackaged should it have to be mailed to a remote location for repair.)

FIGURE 3



H. Bits of packing materials sometimes stick to the equipment, so clean away any packing residue as needed

I. Complete assembly according to manufacturer's guidelines and keep all documents and owner's manual with the computer

III. **Components required for system hookup**

A. Microcomputer unit

B. Microprocessor printed circuit board (mother board)

C. Disk drive or tape storage facility

D. Video display unit

E. Keyboard

(NOTE: The mother board, disk drive or tape facility, video display unit, and keyboard may be integrated with the unit or may be separate components that require proper hookup.)

F. Printer (optional)

G. Modem (optional)

H. Connector cables as required

INFORMATION SHEET

IV. Guidelines for internal system hookup

A. Determine the extent of assembly required and the order of assembly by referring to manufacturer's instructions

(NOTE: Remember, these instructions should have been packaged with the computer and saved at the time the computer was unpacked.)

B. If the microcomputer is an integrated system, it requires no additional assembly, and is ready to power up and test

Example: TRS-80 Models III and IV are integrated systems

C. If the microcomputer comes with a CPU as a separate component or has separate printed circuit cards for certain controller functions, the case must be opened and every screw must be carefully set aside for later replacement

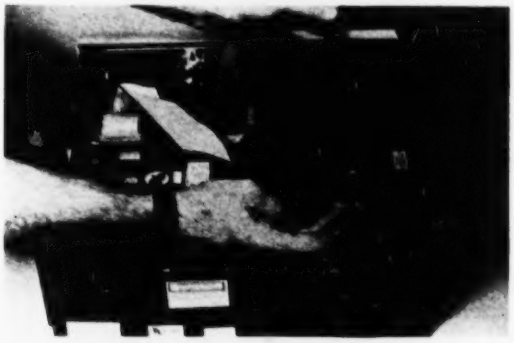
D. As assembly requires, remove the CPU from its packing box and check for packing inside the computer that may have to be removed so the CPU can be properly inserted

(NOTE: Even some integrated units have packing over integrated printed circuit boards to hold them in place while shipping, so check directions carefully and remove packing as instructed.)

E. Unpack other printed circuit boards as required and install them as directed while being especially careful not to touch connectors or leads taken from static-protecting bags (Figure 4)

(NOTE: In the case of Apple, Zenith, IBM, and others, you may have to install disk drive controller cards, serial or parallel printer drive cards, additional memory cards, or a video display card, and all cards required should be properly installed at set-up time so the cover will not have to be removed again.)

FIGURE 4



INFORMATION SHEET

F. Watch carefully for card slots that have protective covers screwed in place because these require installation of card guides and the cards themselves have to be fastened in place with the same screws that held the protective slot covers

(NOTE: IBM systems have protective covers that have to be removed.)

G. Where no card guides are required, the printed circuit card is inserted directly into the connector slot

(NOTE: Apple systems are handled this way.)

H. Although printed circuit cards can sometimes go into any available slot, it is always best to check the manufacturer's recommendations

I. Memory cards have specific slots reserved for them, and they should always be installed to specifications

J. Double check all boards and cards for good seating before replacing the cover

V. **Guidelines for completing system hookup**

A. After all internal boards and cards have been installed, replace the microcomputer cover and MAKE SURE THAT EVERY SCREW THAT WAS REMOVED IS PUT BACK IN PLACE AND FIRMLY SECURED

(CAUTION: In many systems, the cover screws act as part of the bond necessary for the full static shielding required by the FCC.)

B. If the video display unit is a separate component, plug it into the proper connector on the base of the microcomputer

(NOTE: Since connectors are different for each type of output or input, it is difficult to plug them into the wrong connections.)

C. If the keyboard is a separate unit, plug it into the proper connector

(NOTE: Most keyboard connectors have a slotted or indented metal locator guide with a unique shape to assure proper connection.)

D. If the keyboard connector has attachment screws, be sure they are in place and firmly secured

E. Double check all connections for good seating before hooking up any peripherals

INFORMATION SHEET

VI. **Guidelines for hooking up disk drives**

A. When the disk drive comes as a separate component, unpack the drive with care, save the box and packing, and save all documents that come with the drive

B. Open the door of the drive(s) and remove the cardboard protector

C. Save the cardboard protector so that the customer can place it back in the drive anytime it is moved and so that it can be replaced, especially if the drive has to be packed and shipped for repair

D. Most disk drives hook into the microcomputer with a ribbon cable connector that fits into the pins on an interface card

E. If the connector has holding clips, make sure they are snapped into place and double check all disk drive connections

VII. **Guidelines for hooking up printers and modems**

A. If the printer is still in the shipping box, unpack it with the same care exercised in unpacking the computer, and save the shipping box, packing, and all documents that accompany the printer

B. Read the manufacturer's directions carefully, and if required, remove screws, wire ties, or any slotted plastic sleeves used to protect critical mechanical parts during shipping

(CAUTION: If protective devices are not removed from a printer before powering up the equipment, the printer will probably malfunction or both the printer and the microcomputer could be damaged.)

C. Check the printer cable to make sure it is the right one for the printer and the microcomputer

(CAUTION: This is one of the most common errors in setting up a system and can lead to all kinds of problems if it is not done right from the start.)

D. Read the manufacturer's instructions carefully to make sure the cable is placed in the proper connector because A WRONG CONNECTION CAN DAMAGE THE PRINTER, THE MICROCOMPUTER, OR BOTH

(NOTE: Many printer cables use the standard DB-25 connector for both serial and parallel connections, and it is possible to connect a serial printer to a parallel connector or vice versa.)

E. Put cable hold-down attachments in place and secure them firmly with screws

(NOTE: Most cables, especially larger ones, have secured hold-down attachments because the cable weight can easily cause the cable to come loose from its connection.)

INFORMATION SHEET

F. When adding a modem to a system, unpack the modem with care and save the shipping box, packing, and all documents that come with the modem

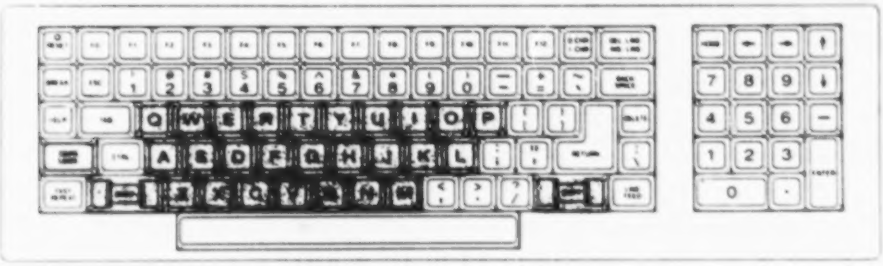
G. A modem is usually hooked up to the serial connection, and in all cases, the manufacturer's instructions should be followed

VIII. **Microcomputer keyboards**

A. Alphanumeric — A reference to the fact that most computers have typewriter-like keyboards that contain the letters of the alphabet, numbers, and characters used in punctuation (Figure 5)

(NOTE: Since the six letters from left to right on the upper row of the letter keys are Q, W, E, R, T, and Y, these keyboards are sometimes called Qwerty keyboards.)

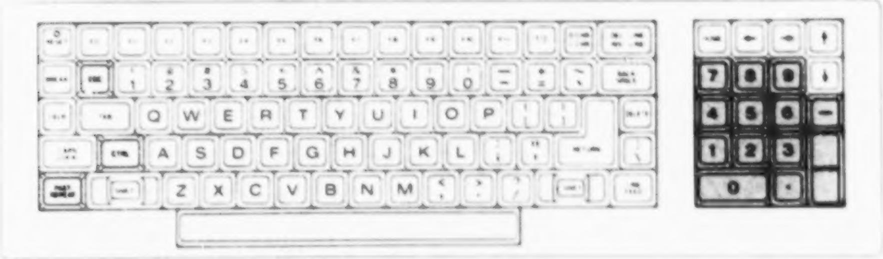
FIGURE 5



Courtesy Zenith Data Systems

B. Numeric keypads — As microcomputers become more popular in business applications, these number pads that function like adding machine keys are showing up on almost all keyboards because of the speed they permit for handling large amounts of numerical input (Figure 6)

FIGURE 6



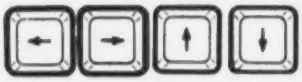
Courtesy Zenith Data Systems

INFORMATION SHEET

IX. Important keys and their functions

A. Cursor keys — These four keys point up, down, left, and right to indicate the direction of cursor movement (Figure 7)

FIGURE 7



Courtesy Zenith Data Systems

B. Control key — This key changes the functions of alphanumeric keys so they can serve other purposes such as erasing characters, resetting the microcomputer, working with special routines, or special diagnostic applications (Figure 8)

FIGURE 8

Courtesy Zenith Data Systems

C. Caps lock — This key has to be pushed and held to change a letter from lower to upper case, and affects only the keys of the alphabet (Figure 4)

D. Shift lock — This key (or keys) has to be pushed down to generate the upper character available on the number punctuation, and special character keys (Figure 9)

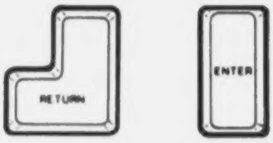
FIGURE 9

Courtesy Zenith Data Systems

INFORMATION SHEET

E. Return or Enter keys — The key name depends on the system, but return and enter are commands that terminate a program operation, enter it in memory, and place the microcomputer in the next cursor position (Figure 10)

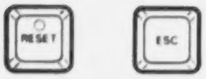
FIGURE 10



Courtesy Zenith Data Systems

F. Reset and Escape keys — These keys usually terminate programming and erase data currently stored in RAM (Figure 11)

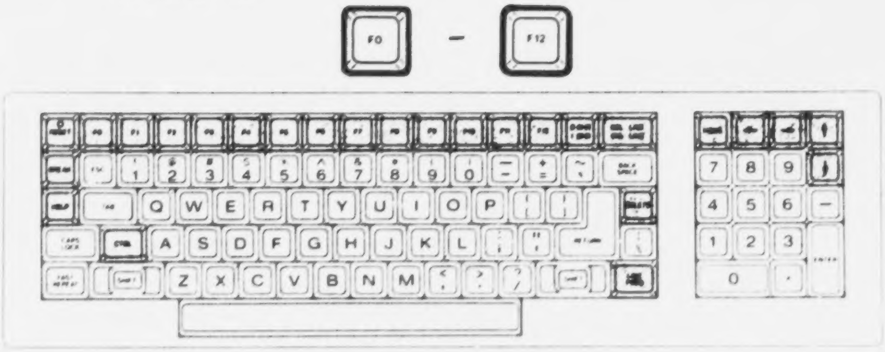
FIGURE 11



Courtesy Zenith Data Systems

G. Function keys — These keys are usually labeled with an "F" to indicate they are function keys (F0, F1, F2, etc.), and they serve single functions or can be programmed for functions to fit program needs (Figure 12)

FIGURE 12



Courtesy Zenith Data Systems

INFORMATION SHEET

X. **Power on/off and initialization routines**

A. Double check all connections

B. Plug the microcomputer into a reliable grounded power source

(NOTE: A "go" "no go" plug is useful for checking proper ground because the plug will only go into a receptacle with a proper ground and will not go into an improperly grounded receptacle.)

C. Read carefully the start-up procedure recommended by the manufacturer

D. Turn the power switch on with the following procedure:

1. If the DOS floppy disk must be inserted in the drive before the power switch is turned on, remove the DOS from the jacket, insert it properly in the drive, and close the drive door

2. If the DOS floppy disk should not be inserted until after the power switch is turned on, then turn on the power switch and then remove the DOS from its jacket, insert it properly in the disk drive, and close the door

(CAUTION: Putting the DOS floppy into the drive before or after turning on the power is extremely important because the DOS floppy may be damaged if it is inserted in the wrong sequence.)

E. Permit the system to warm up

(NOTE: A microcomputer properly warmed up should show some type of clear, legible data on the video display unit.)

F. Continue by pressing the keys required to make the system recognize the DOS

G. A recommended alternative to using the DOS for initial start-up is to use a diagnostic disk if it is available, and run the entire diagnostics before operating the system with the DOS

(NOTE: From the very beginning, start exercising your senses of sight and sound by watching for the red light that comes on at the front of the disk drive to indicate that it is operating, and by listening for the sound the disk drive makes when it is operating.)

H. After running the diagnostic disk or DOS disk, make sure the red light is out and the disk drive is silent to indicate the drive has completed its reading routine

INFORMATION SHEET

I. Turn the power off and remove the floppy or vice versa according to manufacturer's recommendations

J. After removing the diagnostic disk or the DOS disk, put the floppy back into its jacket

(NOTE: The rule for handling a floppy disk is simple: when it's not in the disk drive, it belongs in its protective jacket.)

K. After the floppy disk is removed, LEAVE THE DRIVE DOOR(S) OPEN

(**CAUTION:** Since disk drives are designed to run only for short periods of time, leaving the drive door closed would automatically engage the drive if someone else by chance turned the computer on, and this could easily cause the drive to run an excessive amount of time and damage it.)

XI. **Operating manuals**

A. The most important document for any microcomputer is the owner's manual or user's manual that comes with the equipment

B. The owner's manual should be given to the customer at the time of purchase, and the customer should be encouraged to:

1. Read all introductory materials in the manual and pay particular attention to items labeled "Read Me First"

2. Examine the limited warranty from the manufacturer and understand that the warranty includes specific customer responsibilities as well as manufacturer guarantees

3. Fill out and return the registration card so that the customer will be notified of any updates in the DOS

(NOTE: Some manufacturers include a "change of address" card to further assure customers that update notifications, and other manufacturer's recommend that the the customer ask about software updates from time to time at the store where they purchase the computer.)

C. Some owner's manuals are reasonably complete, but others are so abbreviated that they frequently require an additional user's guide which presents more in-depth programming information

D. All owner's manuals or operating manuals for peripherals such as printers and disk drives should be delivered to the customer at the time of purchase

INFORMATION SHEET

XII. **Ways proper set-up procedures help eliminate future problems**

A. Proper handling of components in static-protecting bags will assure that they function properly from the start

B. Saving the protective cardboards from disk drives will assure that the customer will see them, know what they are for, and use them any time a drive is moved about

C. Seating components properly and securing cables with hold-down attachments will eliminate troublesome connector problems

D. Placing the microcomputer where it will get plenty of ventilation will help control all sorts of malfunctions caused by overheating

E. Saving the original shipping box and packing will assure that the microcomputer or components can be properly packed again should they ever have to be shipped to a remote location for repair

F. Operating the microcomputer with the DOS or with a diagnostic disk will usually assure that there are no initial operating problems

G. Making a backup disk as the original diagnostics program is run will serve as an invaluable reference for any future troubleshooting problems with the entire system

(NOTE: The procedure for making a backup will be covered in the next unit of instruction.)

H. Keeping records of set-up dates and set-up procedures will serve to accurately start the computer's history and encourage the customer to return the computer to the place of purchase for adjustment or repair

ASSEMBLY AND START UP PROCEDURES
UNIT IV

JOB SHEET #1 — HOOK UP A MICROCOMPUTER SYSTEM

A. Tools and materials

1. Microcomputer, disk drive, printer, and video display and connector cables
2. Screwdrivers, standard and Phillips
3. Nutdrivers, 3/16" and 1/4"
4. Operating manual
5. Diagnostic disk

B. Procedure

1. Read the section of the operator's manual that covers the setup procedure and pay special attention to warnings about parts handling and procedures for protection from static discharge
2. Remove computer from any packing
3. Open case, if required
4. Remove internal packing, if required
5. Install required printed circuit cards and set system switches as operating manual directs

   (CAUTION: Any board packed in a static protecting bag should be black, light pink, or a smokey silver colored plastic bag should be handled in a fashion such as not to touch the electrical connectors or leads on the components.)

6. Install all boards, replace case cover and replace all screws
7. Connect peripherals, keyboard, disk drive, printer, and video display with proper cables
8. Remove cardboard from disk drive
9. Plug computer into power supply

   (CAUTION: DO NOT DEFEAT the third wire ground circuit; it is vital for protection of the system.)

JOB SHEET #1

10. Check to see if diagnostic disk should be placed in the drive before or after the computer is turned on
11. Turn computer on
12. Follow all steps in the procedure indicated on the video display by the diagnostic program
13. Have your instructor check your work

ASSEMBLY AND START UP PROCEDURES
UNIT IV

JOB SHEET #2 — OPERATE A MICROCOMPUTER SYSTEM TO OBSERVE INTERACTION OF SYSTEM COMPONENTS

A. Tools and materials

1. Computer system
2. Operating manual
3. Application software as selected by instructor

B. Procedure

1. Review fundamental operating instructions in operator's manual
2. Initialize the system and load the program from disk, tape, or keyboard
3. Proceed with the program as instructed until task is completed
4. Before removing software or turning micro off, be certain that any procedures designed to protect file data are completed before termination of the program
5. Pay special attention to sequence on/sequence off because with some micros this affects either the hardware or software functions
6. Have your instructor check your work

ASSEMBLY AND START UP PROCEDURES
UNIT IV

NAME ________________________

TEST

1. Match the terms on the right with their correct definitions.

______a. A copy made of any form of software or program information that would be difficult or expensive to replace if it were lost or damaged

______b. The process of getting a computer ready to perform programming operations, and is sometimes called booting up, loading, or initializing

______c. A shortened reference to a printed circuit board

______d. Connectors built into a system bus for the specific purpose of accepting printed circuit boards designed to drive peripherals or enhance system capacity or performance

______e. A character on a display screen used to indicate position, and it may be underlined or appear as a graphics block

______f. Disk operating system, the software required to boot a system up and provide various utility operations such as permitting a user to communicate with disk drives

1. Card slots
2. Backup
3. Cursor
4. Card
5. Boot
6. DOS

2. Arrange in order the steps in unpacking a microcomputer by placing the correct sequence number in the appropriate blank.

______a. Return all packing material, especially any contoured styrofoam around individual components, to the shipping box and save the box

______b. Complete assembly according to manufacturer's guidelines and keep all documents and owner's manual with the computer

______c. Set the box upright (the box will probably have arrows indicating "this side up") so that the components can be unpacked in the opposite order they were packed

TEST

______d. Open the box carefully and be sure the knife or opener does not penetrate sealing tape far enough to damage contents

______e. Check the box or crate the computer was shipped in to make sure that there is no evident exterior shipping damage that might have damaged the contents

______f. Remove and save any shipping documents or other materials attached to the shipping box

______g. Bits of packing materials sometimes stick to the equipment, so clean away any packing residue as needed

______h. Remove the document package(s) inside the box and find the sheet or document that outlines the assembly procedure and system hookup procedure

______i. Remove components carefully and place them onto a clean work area

3. List components required for system hookup.

a. ____

b. ____

c. ____

d. ____

e. ____

f. ____

g. ____

h. ____

4. Complete the following statements concerning guidelines for internal system hookup by inserting the word(s) that best completes each statement.

a. Determine the extent of ____________ required and the order of ____________ by referring to manufacturer's instructions

b. If the microcomputer is an ____________ system, it requires no additional assembly, and is ready to power up and test

c. If the microcomputer comes with a ____________ as a separate component or has separate printed circuit cards for certain controller functions, the ____________ must be opened and every screw must be carefully set aside for later replacement

TEST

d. As assembly requires, remove the ____________ from its packing box and check for packing inside the computer that may have to be removed so the ____________ can be properly inserted

e. Unpack other ____________ ____________ ____________ as required and install them as directed while being especially careful not to touch connectors or leads taken from static-protecting bags

f. Watch carefully for card slots that have protective covers screwed in place because these require installation of card ____________ and the cards themselves have to be fastened in place with the same screws that held the protective slot covers

g. Where no ____________ ____________ are required, the printed circuit card is inserted directly into the connector slot

h. Although printed circuit cards can sometimes go into any available slot, it is always best to check the ____________ ____________

i. Memory cards have specific slots reserved for them, and they should always be installed to specifications

j. Double check all boards and cards for good ____________ before replacing the cover

5. Select true statements concerning guidelines for completing system hookup by placing an "X" in the appropriate blanks.

_____a. After all internal boards and cards have been installed, replace the microcomputer cover and MAKE SURE THAT EVERY SCREW THAT WAS REMOVED IS PUT BACK IN PLACE AND FIRMLY SECURED

_____b. If the video display unit is a separate component, plug it into the proper connector on the base of the microcomputer

_____c. If the keyboard is a separate unit, plug it into the proper connector

_____d. If the keyboard connector has attachment screws, be sure they are in place and firmly secured

_____e. Double check all connections for good seating before hooking up any peripherals

6. Complete the following statements concerning guidelines for hooking up disk drives by inserting the word(s) that best completes each statement.

a. When the disk drive comes as a separate component, unpack the drive with care, save the box and packing, and save all ____________ that come with the drive

b. Open the door of the drive(s) and remove the ____________ ____________

TEST

c. Save the ____________ ____________ so that the customer can place it back in the drive anytime it is moved and so that it can be replaced, especially if the drive has to be packed and shipped for repair

d. Most disk drives hook into the microcomputer with a ____________ cable connector that fits into the pins on an ____________ card

e. If the connector has ____________ clips, make sure they are snapped into place and double check all disk drive connections

7. Select true statements concerning guidelines for hooking up printers and modems by placing an "X" in the appropriate blanks.

_____a. If the printer is still in the shipping box, unpack it with the same care exercised in unpacking the computer, and save the shipping box, packing, and all documents that accompany the printer

_____b. Read the manufacturer's directions carefully, and if required, remove screws, wire ties, or any slotted plastic sleeves used to protect critical mechanical parts during shipping

_____c. Check the printer cable to make sure it is the right one for the printer and the microcomputer

_____d. Read the manufacturer's instructions carefully to make sure the cable is placed in the proper connector because A WRONG CONNECTION CAN DAMAGE THE PRINTER, THE MICROCOMPUTER, OR BOTH

_____e. Put cable hold-down attachments in place, but do this only for large cables

_____f. When adding a modem to a system, unpack the modem with care and save the shipping box, packing, and all documents that come with the modem

_____g. A modem is usually hooked up to the parallel connection, and in all cases, the manufacturer's instructions should be followed

8. Distinguish between microcomputer keyboards by placing an "X" next to the characteristics of numeric keypads.

_____a. As microcomputers become more popular in business applications, these number pads that function like adding machine keys are showing up on almost all keyboards because of the speed they permit for handling large amounts of numerical input

_____b. A reference to the fact that most computers have typewriter-like keyboards that contain the letters of the alphabet, numbers, and characters used in punctuation

TEST

9. Match important keys with their functions.

______a. These four keys point up, down, left, and right to indicate the direction of cursor movement

______b. This key changes the function of the alphanumeric keys so they can be serve other purposes such as erasing characters, resetting the microcomputer, working with special routines, or special diagnostic applications

______c. This key has to be pushed and held to change a letter from lower to upper case, and affects only the keys of the alphabet

______d. This key (or keys) has to be pushed down to generate the upper character available on the number, punctuation, and special character keys

______e. The key name depends on the system, but return and enter are commands that terminate a program operation, enter it into memory, and place the microcomputer in the next cursor position

______f. These keys usually terminate programming and erase data currently stored in RAM

______g. These keys are usually labeled with an "F" to indicate they are function keys and they serve single functions or can be programmed for functions to fit program needs

1. Control key
2. Reset and Escape keys
3. Return or Enter keys
4. Cursor keys
5. Caps lock
6. Function keys
7. Shift lock

10. Complete the following statements concerning power on/off and initialization routines by inserting the word(s) that best completes each statement.

a. ____________ ____________ all connections

b. Plug the microcomputer into a reliable ____________ power source

c. Read carefully the ____________ ____________ procedure recommended by the manufacturer

d. Turn the power switch on with the following procedure:

   1) If the DOS floppy disk must be inserted in the drive before the power switch is turned on, remove the DOS from the jacket, insert it properly in the drive, and ____________ the drive door

   2) If the DOS floppy disk should not be inserted until after the power switch is turned on, then turn on the power switch and then remove the DOS from its jacket, insert it properly in the disk drive, and ____________ the door

TEST

e. Permit the system to ____________ ____________

f. Continue by pressing the keys required to make the system recognize the ____________

g. A recommended alternative to using the DOS for initial start-up is to use a diagnostic disk if it is available, and run the entire ____________ before operating the system with the DOS

h. After running the diagnostic disk or DOS disk, make sure the ____________ light is out and the disk drive is silent to indicate the drive has completed its reading routine

i. Turn the power off and remove the floppy or vice versa according to manufacturer's ____________

j. After removing the diagnostic disk or the DOS disk, put the floppy disk back ____________ ____________ ____________

k. After the floppy disk is removed, ____________ ____________ ____________ ____________ ____________

11. Complete the following statements concerning operating manuals by inserting the word(s) that best completes each statement.

a. The most important document for any microcomputer is the owner's manual or ____________ manual that comes with the equipment

b. The owner's manual should be given to the customer at the ____________ ____________ ____________, and the customer should be encouraged to:

1) Read all introductory materials in the manual and pay particular attention to items labeled ____________ ____________ ____________

2) Examine the limited ____________ from the manufacturer and understand that the ____________ includes specific customer responsibilities as well as manufacturer guarantees

3) Fill out and return the ____________ card so that the customer will be notified of any updates in the DOS

c. Some owner's manuals are reasonably complete, but others are so abbreviated that they frequently require an additional ____________ ____________ which presents more in-depth programming information

d. All owner's manuals or operating manuals for peripherals such as ____________ and ____________ ____________ should be delivered to the customer at the time of purchase

TEST

12. List ways proper setup procedures help eliminate future problems by inserting the word(s) that best completes items in the following list.

    a. Proper handling of components in ____________ ____________ bags will assure that they function properly from the start

    b. Saving the ____________ ____________ from disk drives will assure that the customer will see them, know what they are for, and use them any time a drive is moved about

    c. ____________ components properly and securing cables with ____________ ____________ ____________ will eliminate troublesome connector problems

    d. Placing the microcomputer where it will get plenty of ____________ will help all sorts of malfunctions caused by ____________

    e. Saving the original ____________ ____________ and ____________ will assure that the microcomputer or components can be properly packed again should they ever have to be shipped to a remote location for repair

    f. Operating the microcomputer with the ____________ or with a ____________ ____________ will usually assure that there are no initial operating problems

    g. Making a ____________ disk as the original diagnostics program is run will serve as an invaluable reference for any future troubleshooting problems with the entire system

    h. Keeping records of set-up dates and set-up procedures will serve to accurately start the computer's history and encourage the customer to return the computer to the ____________ ____________ ____________ for adjustment or repair

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

13. Demonstrate the ability to:

    a. Hook up a microcomputer system. (Job Sheet #1)

    b. Operate a microcomputer system to observe interaction of system components. (Job Sheet #2)

ASSEMBLY AND START UP PROCEDURES
UNIT IV

ANSWERS TO TEST

1. a. 2
   b. 5
   c. 4
   d. 1
   e. 3
   f. 6

2. a. 7
   b. 9
   c. 3
   d. 4
   e. 1
   f. 2
   g. 8
   h. 5
   i. 6

3. a. Microcomputer unit
   b. Microprocessor printed circuit board
   c. Disk drive or tape storage facility
   d. Video display unit
   e. Keyboard
   f. Printer (optional)
   g. Modem (optional)
   h. Connector cables as required

4. a. Assembly, assembly
   b. Integrated
   c. CPU, case
   d. CPU, CPU
   e. Printed circuit boards
   f. Guides
   g. Card guides
   h. Manufacturer's recommendations
   i. Specific
   j. Seating

5. a,b,c,d,e

6. a. Documents
   b. Cardboard protector
   c. Cardboard protector
   d. Ribbon, interface
   e. Holding

7. a,b,c,d,f

ANSWERS TO TEST

8. a

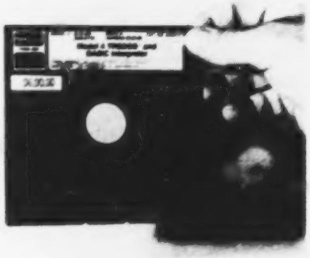
9. a. 4
   b. 1
   c. 5
   d. 7
   e. 3
   f. 2
   g. 6

10. a. Double check
    b. Grounded
    c. Start up
    d. 1) Close
       2) Close
    e. Warm up
    f. DOS
    g. Diagnostic, diagnostics
    h. Red
    i. Recommendations
    j. Into its jacket
    k. LEAVE THE DRIVE DOOR(S) OPEN

11. a. User's
    b. Time of purchase
       1) Read Me First
       2) Warranty, warranty
       3) Registration
    c. User's guide
    d. Printers, disk drives

12. a. Static-protecting
    b. Protective cardboards
    c. Seating, hold-down attachments
    d. Ventilation, overheating
    e. Shipping box, packing
    f. DOS, diagnostic disk
    g. Backup
    h. Place of purchase

13. Performance skills evaluated according to procedures outlined in the job sheets.



OPERATING SYSTEMS
UNIT V

UNIT OBJECTIVE

After completion of this unit, the student should be able to discuss the functions of disk-based and ROM-based operating systems, and how to load an operating system. The student should also be able to list relationships of operating systems and hardware, and make a backup disk. These competencies will be evidenced by correctly performing the procedures outlined in the job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to operating systems with their correct definitions.
2. Differentiate between operating systems.
3. Complete statements concerning typical functions of disk-based operating systems.
4. Complete statements concerning typical functions of ROM-based operating systems.
5. Select true statements concerning operating systems/hardware relationships.
6. Complete statements concerning procedures for loading operating systems.
7. Select true statements concerning relationships of logical/physical devices.
8. Complete statements concerning Basic Input/Output Systems and CP/M.
9. Complete statements concerning guidelines for making a backup disk.
10. Match parts of a disk with their functions.
11. Demonstrate the ability to:
    a. Backup a disk on an Apple computer. (Job Sheet #1)
    b. Backup a disk on a TRS-80 computer. (Job Sheet #2)
    c. Backup a disk on an IBM Personal Computer. (Job Sheet #3)

OPERATING SYSTEMS
UNIT V

SUGGESTED ACTIVITIES

A. Provide student with objective sheet.

B. Provide student with information and job sheets

C. Make transparency.

D. Discuss unit and specific objectives.

E. Discuss and demonstrate the procedures outlined in the job sheets.

F. Demonstrate how to boot up a system that uses a DOS, and then demonstrate how to boot up a ROM-based system such as a Commodore Vic-20 or 64.

G. Read the job sheets carefully and try to have available an Apple, a TRS-80, and an IBM PC for the students to use as they practice making backup disks, and introduce the backup procedures with a review of procedures for using the DOS's for each of the systems.

H. Have an old disk available so you can demonstrate where the disk is most subject to wear and how the disk is put together.

I. Give test.

CONTENTS OF THIS UNIT

A. Objective sheet

B. Information sheet

C. Transparency Master 1 — Parts of a 5 ¼" Disk

D. Job sheets

   1. Job Sheet #1 — Backup a Disk on an Apple Computer

   2. Job Sheet #2 — Backup a Disk on a TRS-80 Computer

   3. Job Sheet #3 — Backup a Disk on an IBM Personal Computer

E. Test

F. Answers to test

REFERENCES USED IN DEVELOPING THIS UNIT

A. *Commodore 64 User's Guide.* Wayne, PA 19087: Commodore Business Machines, Inc., Computer Systems Division, 1982.

B. *Commodore Programmer's Reference Guide.* Wayne, PA 19087: Commodore Business Machines, Inc., Computer Systems Division, 1982.

C. *TRS-80® Model III Disk System Owner's Manual.* Ft. Worth, TX 76102: Tandy Corporation, 1980.

D. *Disk Operating System by Microsoft.* Boca Raton, FL 33432: International Business Machines Corp., 1980.

E. *Apple II the Dos Manual Disk Operating System.* Cupertino, CA 95014: Apple Computer Inc., 1981.

F. *Z-100 User's Manual.* St. Joseph, MI 49085: Zenith Data Systems, 1983.

OPERATING SYSTEMS
UNIT V

INFORMATION SHEET

I. **Terms and definitions**

A. Backup — A copy of material from its original format on tape or a floppy or hard disk onto another tape, floppy, or hard disk for the purpose of retaining the information in the event the original is erased or damaged

B. Debugging — The process of finding and correcting errors in a program

C. Editing — The process of changing data, a program line, or a complete program

D. Firmware — Programs built into ROM at the time a microcomputer is manufactured so that the programs can be used on command, but not erased when power is turned off

E. Floppy disk — The jacketed oxide-coated disk used to magnetically write data into storage or to be read from for data retrieval

(NOTE: A disk is sometimes called a floppy, sometimes called a diskette, and sometimes spelled with a final "c" instead of a final "k", but they all mean the same thing.)

F. Handshake — The hardware configuration in an interface device or cable that controls the signal exchange needed when two or more computer components exchange information

G. Interface — A connecting device required for the signal conversion needed for two or more computer components to talk with each other

H. Protocol — The software format that controls the signal timing of information exchange between two communicating components

I. Utility — A program that runs outside the operating system to provide a user with a specific service such as accessing files on a disk

II. **Basic operating systems**

A. ROM-based — Any operating system that operates without a disk drive

B. Disk-based — Any operating system that operates with a DOS

INFORMATION SHEET

III. **Typical functions of disk-based operating systems**

A. Although a DOS performs some of the same functions accomplished in a ROM-based system, the DOS has a number of tasks strictly related to the disk

B. One of the major tasks of the DOS is to control communications between the microcomputer board and the disk system which includes the handshaking protocol

C. The DOS controls handshaking protocol by timing information sent back and forth between the microcomputer and the disk drive

D. When information should be sent to the disk, the protocol will request permission to send the information to the disk, and the disk will relay that information may be sent or place the microcomputer on hold so that information will not be sent at the wrong time

E. As information is received by the disk, the protocol will indicate to the microcomputer that the information has been received and that the next piece of information can be sent and the protocol repeated

F. In addition to controlling handshaking protocol, the DOS must also control:

1. The placement of information on the disk as it is accepted from the microcomputer

2. The loading of information from the disk into RAM at the appropriate place and in the appropriate quantity so information will not be lost by overflowing RAM space

G. The DOS will also contain start up and backup procedures for the DOS

H. A typical DOS will contain a number of utility programs commonly required by a computer user, and these may include:

1. An assembler program

2. A debugging utility

3. An editing utility

4. A file-erasing utility

5. A program-duplicating utility

6. A utility to display file contents and other programs on the video display

INFORMATION SHEET

I. In addition to utilities, the DOS will usually include a program that generates error codes to inform the user of improper programming entries

J. DOS's vary from system to system, and the DOS manual for the system being operated should always be referenced for additional functions

IV. **Typical functions of ROM-based operating systems**

A. To boot up system after power on

B. To read and interpret key closures on the keyboard

C. To send appropriate graphic and text information to the video display unit

D. To execute programs which oversee the interaction of software with hardware or software with other software

E. To supervise the interaction of various hardware features within the system

F. To perform, in some cases, the software interface for the video display

G. To make specified memory checks in both ROM and RAM which may also be a part of self-diagnostic functions

H. To serve communications features that require character generation or character interpretation for receiving and sending data

(NOTE: Not all systems have boards with communications features, but a Commodore 64 is one system that uses the serial port to communicate with the disk drive, and part of that communications function is in ROM.)

V. **Operating systems/hardware relationships**

A. Each operating system is designed for and dependent on the hardware for that specific system

B. Unless an operating system is designed for specific hardware it will not run even when the hardware has similar subsystems

Example: The Zenith Z-100 and Z-150 both have 8088-based microprocessors and they both use a version of MS-DOS, but the operating systems for the two microcomputers are not interchangeable

C. The operating dependency on hardware is not only tied to the microprocessor chip, but to:

1. Type of memory
2. Where RAM is addressed
3. Disk storage capacity
4. Keyboard entry techniques
5. Almost all physical characteristics

INFORMATION SHEET

D. One of the prime rules for troubleshooting microcomputer systems is tied to the operating system dependency on hardware: MAKE SURE YOU HAVE THE OPERATING SYSTEM DESIGNED FOR THE SPECIFIC HARDWARE BEING USED

VI. **Procedures for loading operating systems**

A. Read the manufacturer's instructions and follow them

B. Loading a ROM-based operating system is usually as simple as turning the microcomputer on

C. Loading a disk-based operating system requires turning the microcomputer on and properly inserting the DOS floppy into the correct drive or inserting the floppy and then turning the microcomputer on

D. Systems with both DOS and ROM usually expect the DOS when they are first turned on, but a "Reset" or "Control" function key or combination of keys can be used to get to ROM

E. When working with an unfamiliar system and there are questions about how the operating system works, do not guess or assume it is like the operating system on some other microcomputer — read the operator's manual

VII. **Relationships of logical/physical devices**

A. Some operating systems require using the system to designate the drive number or letter through which the program will operate

(NOTE: This is true of both CP/M and MS-DOS.)

B. Through program logic, other systems require that a specific physical device be designated for program operation

(NOTE: With the Apple, it requires designation of a slot to work through to reach the physical device.)

C. Logical operations can function with given physical devices

VIII. **Basic Input/Output Systems and CP/M**

(NOTE: CP/M is a registered trademark of Digital Research, Inc.)

A. Basic input/output systems, BIOS, function with certain operating systems such as CP/M to control the physical input and output of the microprocessor with the respect to the disk and other peripherals

Example: CP/M uses the BIOS as a subset and it is the BIOS subset of the program which is rewritten each time CP/M is designed to work on a new or different piece of hardware

INFORMATION SHEET

B. The CP/M operating system consists of subsets:

1. BDOS — Controls the disk drive
2. BIOS — Controls input/output devices
3. FDOS — File controls for input/output to the floppy

IX. **Guidelines for making a backup disk**

A. Determine if the system you are working with has the backup or duplication program built into the DOS or included in some kind of system disk

(NOTE: Backing up a disk is a good example of a utility program.)

B. Determine whether the backup procedure requires one disk drive or two

(NOTE: With backup procedures that use only one disk drive, information on the original disk has to be programmed into system memory and then programmed out to the blank or backup disk, and the procedure in Job Sheet #1 shows how this works.)

C. When using a dual disk drive system, know the proper number or letter references for each of the drives because some manufacturers call them A and B while others call them 0 and 1

D. Be sure to handle all disks with care, and be sure that the write-protect notch on any original disk is covered with a tab so that it cannot be accidentally written over in the backup procedure

E. Once a backup is completed, be sure to label it, but write information on the label before you put the label on the disk jacket

X. **Parts of a disk and their functions** (Transparency 1)

A. Plastic disk — A flexible disk coated with a magnetic oxide onto which a read/write head can write data or from which a read/write head can read data

B. Outer envelope — Used by manufacturer for identification and advertising, but it does provide added protection when the disk is being shipped or stored

C. Disk jacket — Made of heavier paper or plastic to provide a permanent protective cover for the disk and add rigid qualities to the disk for handling and improved operational characteristics

INFORMATION SHEET

D. Disk liner — The cloth-like protective sleeve between the disk jacket and the disk that helps keep the disk clean by trapping dust particles

E. Center hole — The point where the disk drive mechanism grabs the disk so it can be rotated

F. Alignment hole — A small hole just off center used for timing and sector alignment

G. Oval access slot — The point where the read/write head accesses the disk to write information to the disk or read information from the disk

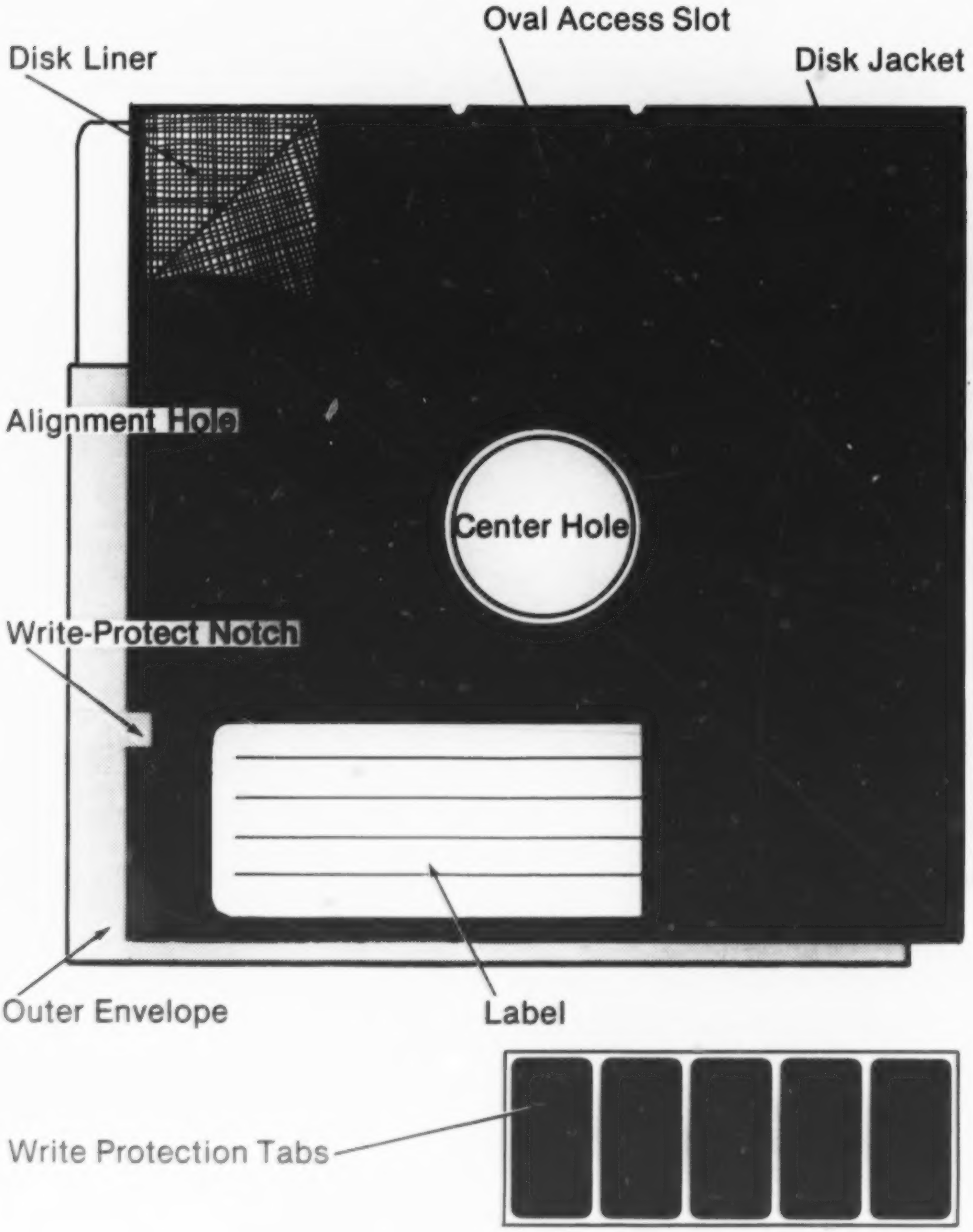
H. Write-protect notch — This notch to the lower left of the alignment hole (as the disk would be placed in a drive) permits writing onto the disk, but when it is covered with a write-protect tab, the system senses the tab and will not write on the disk

(NOTE: On 5 ¼" disks, it is a write-protect notch, but on 8" disks, it is a write-enable notch and must be covered with a tab in order to write to an 8" disk.)

I. Write-protect tabs — These are usually provided when disks are purchased in boxes, are on a peel-off surface, and usually about 1" x ½" so that they will provide a sufficient opaque covering for the write-protect notch

J. Labels — These are usually provided when disks are purchased in a box, and should be filled out prior to application to the disk jacket to eliminate the possibility of marring the surface of the disk

Parts of a 5 ¹/₄″ Disk



OPERATING SYSTEMS
UNIT V

JOB SHEET #1 — BACKUP A DISK ON AN APPLE COMPUTER

A. Tools and equipment

1. Apple microcomputer as selected by instructor
2. Apple disk drive
3. SYSTEM MASTER disk with copy program
4. Original disk with information to be copied
5. Blank disk for backup disk
6. Labels, write-protect tabs, and a felt-tip pen

B. Procedure

(NOTE: This procedure will work with any of the Apple II compatible models, and is specifically written for a system with only one disk drive.)

1. Place a write-protect tab over the original disk so the information on it will not be accidentally erased
2. Insert the SYSTEM MASTER disk into the disk drive which is called Disk Drive 1

   (NOTE: There are two programs on the SYSTEM MASTER for copying a disk as a whole. Both copy programs, called COPYA and COPY, function exactly alike. However, use COPYA when your computer is running Applesoft BASIC and COPY when your computer is running Integer BASIC.)

3. Check that the drive door is completely closed
4. Turn the computer on
5. Look at the cursor and determine which BASIC language you are using

   (NOTE: Remember a] prompt means your computer is running Applesoft BASIC; a > prompt means your computer is running Integer BASIC.)

6. Type RUN COPYA if you see the] prompt; type RUN COPY if you see the prompt >
7. Check your typing for errors, then press [RETURN]

   (NOTE: Pressing [RETURN] starts the copy program running.)

JOB SHEET #1

8. Press [RETURN] three times to accept the values the computer assumes you will want; these values are called defaults

   (NOTE: A default is any value that is automatically used by a computer system if another value is not given.)

9. Press [1] to tell the copy program that the duplicate disk will also be in Disk Drive 1

   (NOTE: When the message PRESS [RETURN] KEY TO BEGIN COPY appears on display, it means that the program knows where to find information and where to put a copy of information. Information has not been transferred from disk yet.)

10. Press [RETURN] to begin the copy process

    (NOTE: You will see INSERT ORIGINAL DISK AND PRESS [RETURN] on display.)

11. Remove SYSTEM MASTER disk

12. Insert original disk into Disk Drive 1

13. Press [RETURN] to tell computer original disk has been inserted

    (NOTE: Drive 1 light will come on and you will see READING displayed on screen; then you'll see INSERT DUPLICATE DISK AND PRESS RETURN on the display.)

14. Remove original disk from Drive 1 and insert duplicate disk into Drive 1; press [RETURN]

15. Exchange the duplicate disk in Drive 1 for the original when you see INSERT ORIGINAL DISK AND PRESS [RETURN]

16. Repeat steps 14 and 15 until you see the message DO YOU WISH TO MAKE ANOTHER COPY

    (NOTE: The number of times you have to exchange the original disk for the duplicate depends on how much data is on the original.)

17. Remove disk

18. Write "backup" on the label to identify copy

19. Turn computer OFF

    ☐ Have your instructor check your work

20. Clean up area and return tools and equipment to proper storage, or prepare for next job sheet as directed by your instructor

OPERATING SYSTEMS
UNIT V

JOB SHEET #2 — BACKUP A DISK ON A TRS-80 COMPUTER

A. Tools and equipment

1. TRS-80 microcomputer Model III or Model IV with dual disk drives
2. Original disk with information to be copied
3. Blank disk for backup disk
4. Label, write-protect tabs, and a felt-tip pen

B. Procedure

(NOTE: This backup procedure will work on either a Model III or Model IV TRS-80 and is specifically written for a system with dual disk drives.)

1. Turn the computer ON, and while you're waiting for the system to warm up, check to make sure the write-protect notch on the original disk has a tab over it so it won't be accidentally erased

   (NOTE: After turning on the computer, you will see a red light which indicates the disk drive motors are running. WAIT for this light to go off before proceeding to the next step.)

2. Holding the disk to be copied with the label side up and the read/write window pointing into the drive slot, insert into the lower disk drive (Drive 0)

   (**CAUTION:** Do not force the disk; rather, slide it gently into the opening.)

3. Close the disk drive door
4. Insert a blank disk into Drive 1 (upper disk drive) using the same procedure as in step 2
5. Close the disk drive door
6. Press the [RESET] button

   (NOTE: The RESET button is the orange square located on the upper right side of the keyboard. Wait for the red light to go off before proceeding to the next step.)

7. Enter the date and press [ENTER]

   Example: May 5, 1985 would be written as 05/05/85

JOB SHEET #2

8. Enter the time or, if you wish to bypass this step, press [RETURN]

9. When TRSDOS Ready appears on the screen, type [BACKUP] and press [ENTER]

10. When "SOURCE Drive Number ?" appears on the screen, type number 0 and press [ENTER]

11. When "DESTINATION Drive number?" appears, type number 1 and press [ENTER]

12. When "SOURCE Disk Master Password?" appears, type the password "PASSWORD" that protects the disk and press [ENTER]; unless the destination disk contains data, the backup begins

    (NOTE: Most Radio Shack program disks use PASSWORD as the password.)

13. If the backup disk contains data, two more prompts will appear

14. When asked "Use Disk or not?" type [Y] and press [ENTER] if the disk will be used anyway

    (NOTE: To cancel the backup and return to TRSDOS Ready, type [N] and press [ENTER]

15. If [Y] is entered, the prompt "Do you wish to RE-FORMAT the disk?" will appear

16. Type [Y] and press [ENTER] to reformat the destination disk; type [N] and press [ENTER] to copy the contents of the source disk over the contents of the destination disk

17. When TRSDOS has completed the backup, "Backup Complete" will appear on the screen and the system will return to TRSDOS Ready

18. Remove original disk from the lower disk drive (Drive 0)

19. Remove backup (destination) disk from upper disk drive (Drive 1)

20. Write "backup" on label to identify copy

21. Turn computer OFF

    ☐ Have your instructor check your work

22. Clean up area and return tools and equipment to proper storage, or prepare for next job sheet as directed by your instructor

OPERATING SYSTEMS
UNIT V

JOB SHEET #3 — BACKUP A DISK ON AN IBM PERSONAL COMPUTER

A. Tools and equipment

1. IBM Personal Computer with dual disk drives
2. DOS disk
3. Original disk with information to be copied
4. Blank disk for backup disk
5. Labels, write-protect tabs, and felt-tip pen

B. Procedure

1. Turn monitor ON
2. Insert DOS disk in Disk Drive A
3. Close disk drive door
4. Turn the computer ON
5. Type new date (current date); press [ENTER]
6. Type new time (current time); press [ENTER]

   (NOTE: This must be typed as military time. For example, 4:25 p.m. is represented as 16:25:00.)

7. Make sure A> is displayed prior to typing command

JOB SHEET #3

8. Type diskcopy a: b: and press [ENTER]

   (NOTE: At this point, the screen should resemble Figure 1.)

   FIGURE 1

```
Current date is Tue 1-01-1980
Enter new date: 03-26-1984
Current time is 0:00:25.76
Enter new time:

The IBM Personal Computer DOS
Version 1.10 (C) Copyright IBM Corp. 1981, 1982

A> diskcopy a: b:
Insert source diskette in drive A:
Insert target diskette in drive B:
Strike any key when ready
```

9. Remove DOS disk from Drive A

10. Insert original (source) disk in Disk Drive A

    (NOTE: Put a tab over the write-protect notch so the original data will not be accidentally erased.)

11. Close disk drive door

12. Insert backup (target) disk in Disk Drive B

13. Close disk drive door

14. Press any key

    (NOTE: This tells DOS you are ready. At this point, information is being copied.)

15. Answer question by pressing "Y" for yes or "N" for no when message appears on screen (Figure 2)

    FIGURE 2

```
Copy complete
Copy another (Y/N)?
```

16. Remove both disks

JOB SHEET #3

17. Write "backup" on the label to identify copy

18. Turn monitor OFF

19. Turn computer OFF

    ☐ Have your instructor check your work

20. Clean up area and return tools and equipment to proper storage, or prepare for next job sheet as directed by your instructor

OPERATING SYSTEMS
UNIT V

NAME ______________________

TEST

1. Match the terms on the right with their correct definitions.

_____a. A copy of material from its original format on tape or a floppy or hard disk onto another tape, floppy, or hard disk for the purpose of retaining the information in the event the original is erased or damaged

_____b. The process of finding and correcting errors in a program line, or a complete program

_____c. The process of changing data, a program line, or a complete program

_____d. Programs built into ROM at the time a microcomputer is manufactured so that the programs can be used on command, but not erased when power is turned off

_____e. The jacketed oxide-coated disk used to magnetically write data into storage or to be read from for data retrieval

_____f. The hardware configuration in an interface device or cable that controls the signal exchange needed when two or more computer components exchange information

_____g. A connecting device required for the signal conversion needed for two or more computer components to talk with each other

_____h. The software format that controls the signal timing of information exchange between two communicating components

_____i. A program that runs outside the operating system to provide a user with a specific service such as accessing files on a disk

1. Firmware
2. Protocol
3. Handshake
4. Interface
5. Utility
6. Floppy disk
7. Backup
8. Editing
9. Debugging

2. Differentiate between operating systems by placing an "X" beside the definition of a disk-based operating system.

_____a. Any operating system that operates without a disk drive

_____b. Any operating system that operates with a DOS

TEST

3. Complete the following statements concerning typical functions of disk-based operating systems by inserting the word(s) that best completes each statement.

   a. Although a DOS performs some of the same functions accomplished in a ROM-based system, the DOS has a number of tasks strictly related to the ____________

   b. One of the major tasks of the DOS is to control communications between the ____________ board and the ____________ system which includes the handshaking protocol

   c. The DOS controls ____________ ____________ by timing information sent back and forth between the microcomputer and the disk drive

   d. When information should be sent to the disk, the ____________ will request permission to send the information to the disk, and the disk will relay that information may be sent or place the microcomputer on hold so that information will not be sent at the ____________ time

   e. As information is received by the disk, the ____________ will indicate to the microcomputer that the information has been received and that the next piece of information can be sent and the ____________ ____________

   f. In addition to controlling handshaking protocol, the DOS must also control:

      1) The ____________ of information on the disk as it is accepted from the microcomputer

      2) The ____________ of information from the disk into RAM at the appropriate place and in the appropriate quantity so information will not be lost by overflowing RAM space

   g. The DOS will also contain start up and ____________ procedures for the DOS

   h. A typical DOS will contain a number of utility programs commonly required by a computer user, and these may include:

      1) An ____________ program

      2) A ____________ utility

      3) An ____________ utility

      4) A ____________ ____________ utility

      5) A ____________ ____________ utility

      6) A utility to display ____________ contents and other programs on the video display

   i. In addition to utilities, the DOS will usually include a program that generates ____________ codes to inform the user of improper programming entries

   j. DOS's ____________ from system to system, and the DOS manual for the system being operated should always be referenced for additional functions

TEST

4. Complete the following statements concerning typical functions of ROM-based operating systems by inserting the word(s) that best completes each statement.

   a. To ____________ ____________ system after power on

   b. To read and interpret ____________ closures on the ____________

   c. To send appropriate graphic and text information to the ____________ ____________ ____________

   d. To execute programs which oversee the interaction of ____________ with ____________ or ____________ with other ____________

   e. To supervise the interaction of various ____________ features within the system

   f. To perform, in some cases, the software ____________ for the video display

   g. To make specified memory checks in both ROM and RAM which may also be a part of ____________ ____________ functions

   h. To serve communications features that require ____________ ____________ or character interpretation for receiving and sending data

5. Select true statements concerning operating systems/hardware relationships by placing an "X" in the appropriate blanks.

   (NOTE: For a statement to be true, all parts of the statement must be true.)

   _____a. Each operating system is designed for and dependent on the hardware for that specific system

   _____b. Unless an operating system is designed for specific hardware it will not run on that hardware unless the computer is the same color

   _____c. The operating dependency on hardware is not only tied to the microprocessor chip, but to:

      1) Type of memory
      2) Where RAM is addressed
      3) Disk storage capacity
      4) Keyboard entry techniques
      5) Almost all physical characteristics

   _____d. One of the prime rules for troubleshooting microcomputer systems is tied to the operating system dependency on hardware: MAKE SURE YOU HAVE THE OPERATING SYSTEM DESIGNED FOR THE SPECIFIC HARDWARE BEING USED

TEST

6. Complete the following statements concerning procedures for loading operating systems by inserting the word(s) that best completes each statement.

   a. Read the manufacturer's instructions and ____________ them

   b. Loading a ROM-based operating system is usually as simple as ____________ ____________ ____________ ____________

   c. Loading a disk-based operating system requires turning the microcomputer on and properly inserting the DOS floppy into the correct drive or ____________ ____________ ____________ and then ____________ ____________ ____________ ____________

   d. Systems with both DOS and ROM usually expect the ____________ when they are first turned on, but a "Reset" or "Control" function key or combination of keys can be used to get to ____________

   e. When working with an unfamiliar system and there are questions about how the operating system works, do not guess or assume it is like the operating system on some other microcomputer — ____________ the operator's manual

7. Select true statements concerning relationships of logical/physical devices by placing an "X" in the appropriate blanks.

   _____a. Some operating systems require using the system to designate the drive number or letter through which the program will operate

   _____b. Through program logic, other systems require that a specific physical device be designated for program operation

   _____c. Logical operations can function with all physical devices

8. Complete the following statements concerning basic input/output systems and CP/M by inserting the word(s) that best completes each statement.

   a. Basic input/output systems, BIOS, function with certain operating systems such as CP/M to control the ____________ input and output of the ____________ with the respect to the disk and other peripherals

   b. The CP/M operating system consists of subsets:

      1) BDOS — Controls the ____________ ____________

      2) BIOS — Controls the ____________/____________ devices

      3) FDOS — ____________ controls for input/output to the floppy

TEST

9. Complete the following statements concerning guidelines for making a backup disk by inserting the word(s) that best completes each statement.

   a. Determine if the system you are working with has the backup or duplication program built into the ____________ or included in some kind of system disk

   b. Determine whether the backup procedure requires ____________ disk drive or ____________

   c. When using a dual disk drive system, know the proper number or letter references for each of the drives because some manufacturers call them ____________ and ____________ while others call them ____________ and ____________

   d. Be sure to handle all disks with care, and be sure that the ____________-____________ -____________ on any original disk is covered with a tab so that it cannot be accidentally written over in the backup procedure

   e. Once a backup is completed, be sure to label it, but write information on the label ____________ you put the label on the disk jacket

10. Match parts of a disk with their functions.

______a. A flexible disk coated with a magnetic oxide onto which a read/write head can write data or from which a read/write head can read data

______b. Used by manufacturer for identification and advertising, but it does provide added protection when the disk is being shipped or stored

______c. Made of heavier paper or plastic to provide a permanent protective cover for the disk and add rigid qualities to the disk for handling and improved operational characteristics

______d. The cloth-like protective sleeve between the disk jacket and the disk that helps keep the disk clean by trapping dust particles

______e. The point where the disk drive mechanism grabs the disk so it can be rotated

______f. A small hole just off center used for timing and sector alignment

______g. The point where the read/write head accesses the disk to write information to the disk or read information from the disk

1. Disk liner
2. Write-protect tabs
3. Outer envelope
4. Labels
5. Plastic disk
6. Oval access slot
7. Disk jacket
8. Write-protect notch
9. Center hole
10. Alignment hole

TEST

_____h. This notch to the lower left of the alignment hole (as the disk would be placed in a drive) permits writing onto the disk, but when it is covered with a write-protect tab, system senses the tab and will not write on the disk

_____i. These are usually provided when disks are purchased in boxes, are on a peel-off surface, and usually about 1" × 1/2" so that they will provide a sufficient opaque covering for the write-protect notch

_____j. These are usually provided when disks are purchased in a box, and should be filled out prior to application to the disk jacket to eliminate the possibility of marring the surface of the disk

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

11. Demonstrate the ability to:

    a. Backup a disk on an Apple computer. (Job Sheet #1)

    b. Backup a disk on a TRS-80 computer. (Job Sheet #2)

    c. Backup a disk on an IBM Personal Computer. (Job Sheet #3)

OPERATING SYSTEMS
UNIT V

ANSWERS TO TEST

1. a. 7
   b. 9
   c. 8
   d. 1
   e. 6
   f. 3
   g. 4
   h. 2
   i. 5

2. b

3. a. Disk
   b. Microcomputer, disk
   c. Handshaking protocol
   d. Protocol, wrong
   e. Protocol, protocol repeated
   f. 1) Placement
      2) Loading
   g. Backup
   h. (NOTE: Items may be in some other order, but all items should be present.)
      1) Assembler
      2) Debugging
      3) Editing
      4) File-erasing
      5) Program duplicating
      6) File
   i. Error
   j. Vary

4. a. Boot up
   b. Key, keyboard
   c. Video display unit
   d. Software, hardware, software, software
   e. Hardware
   f. Interface
   g. Self-diagnostic
   h. Character generation

5. a,c,d

6. a. Follow
   b. Turning the microcomputer on
   c. Inserting the floppy, turning the microcomputer on
   d. DOS, ROM
   e. Read

7. a,b

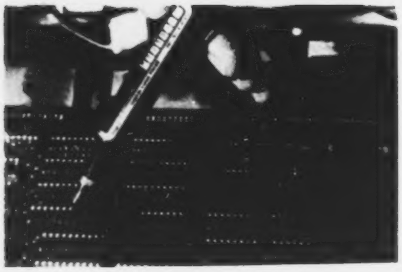
ANSWERS TO TEST

8. a. Physical, microprocessor
   b. 1) Disk drive
      2) Input/output
      3) File

9. a. DOS
   b. One, two
   c. A, B, 0, 1 (order may be reversed)
   d. Write-protect notch
   e. Before

10. a. 5
    b. 3
    c. 7
    d. 1
    e. 9
    f. 10
    g. 6
    h. 8
    i. 2
    j. 4

11. Competencies evaluated according to procedures outlined in the job sheets



TOOLS AND EQUIPMENT
UNIT VI

UNIT OBJECTIVE

After completion of this unit, the student should be able to define the elements in a healthy microcomputer environment, list the steps in using a disk cleaning kit, discuss the uses of basic microcomputer repair tools and test equipment, and use basic tools and test equipment in troubleshooting routines. These competencies will be evidenced by correctly performing the procedures outlined in the job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to tools and equipment with their correct definitions.
2. Complete a list of requirements for a healthy computer environment.
3. Select true statements concerning line protection.
4. Complete statements concerning static control.
5. Complete statements concerning disk head cleaning kits and their uses.
6. Complete statements concerning hand tools and their uses.
7. List test equipment most commonly used.
8. Select true statements concerning how logic probes work.
9. Complete statements concerning how VOM's and DVOM's work.
10. Complete a list of safety precautions for making voltage measurements.
11. Select true statements concerning how a breakout box works.
12. Select true statements concerning vendor support.
13. Match other test equipment with its uses.
14. Demonstrate the ability to:
    a. Check power supply voltages with a DVOM. (Job Sheet #1)
    b. Check system fuses with a DVOM. (Job Sheet #2)

TOOLS AND EQUIPMENT
UNIT VI

SUGGESTED ACTIVITIES

A. Provide student with objective sheet.

B. Provide student with information and job sheets.

C. Make transparencies.

D. Discuss unit and specific objectives.

E. Discuss information sheet.

F. Discuss and demonstrate the procedures outlined in the job sheets.

G. Demonstrate the use of a breakout box.

H. Demonstrate the use of a logic probe and impress upon students the importance of digital test instruments in troubleshooting microcomputer problems.

I. Demonstrate how a head cleaning kit should be properly used and caution students not to overclean heads or clean them too often.

J. Demonstrate the use of a tracer probe, a logic pulser, and an oscilloscope, and discuss how these test instruments help solve troubleshooting problems with digital devices.

K. Outline the rules for using school equipment and the procedures for check out/check in.

L. Give test.

CONTENTS OF THIS UNIT

A. Objective sheet

B. Information sheet

C. Transparency masters

   1. TM 1 — VOM

   2. TM 2 — DVOM

D. Job sheets

   1. Job Sheet #1 — Check Power Supply Voltages with a DVOM

   2. Job Sheet #2 — Check System Fuses with a DVOM

CONTENTS OF THIS UNIT

E. Test

F. Answers to test

REFERENCES USED IN DEVELOPING THIS UNIT

A. Johnston, Chris. *The Microcomputer Builder's Bible.* Blue Ridge Summit, PA 17214: Tab Books Inc., 1982.

B. Brenner, Robert C. *IBM PC Troubleshooting and Repair Guide.* Indianapolis, IN 46268: Howard W. Sams and Co., Inc., 1985.

C. *Black Box Catalog of Data Communications and Computer Devices, Mid-Year, 1984.* Pittsburg, PA 15241: Black Box Corporation, 1984.

D. *The IC Troubleshooters, New Techniques of Digital Troubleshooting, Applications Note 163-2.* Palo Alto, CA 94304: Hewlett-Packard, No date.

TOOLS AND EQUIPMENT
UNIT VI

INFORMATION SHEET

I. **Terms and definitions**

- A. Abrasive — Any substance that can cut, gouge, or mar the surface of another substance
- B. Contamination — Dust, grease, or any particulate matter present in air, or dirt, grease or impurities on somebody's hands or on tools or equipment in a computer environment
- C. Humidifier — A device designed to add controlled amounts of moisture to the air in order to moderate dryness in an indoor space
- D. Vendor — Any company that sells microcomputers or related supplies, devices, or peripherals

II. **Requirements for a healthy computer environment**

- A. The area in which any computer is used should be as free of contamination as possible
- B. A computer should not be exposed to excessive heat, cold, or humidity
- C. Dust covers should be used to cover all pieces of the computer equipment when they are not in use
- D. Smoking should not be permitted in an area where computers are located

  (NOTE: The residue from cigarette, pipe, and cigar smoke contains a tar residue that can play havoc with a keyboard, internal parts of a disk drive, and the oxide surfaces of media.)
- E. Soft drinks or any kinds of liquids that can be spilled should not be consumed around a computer
- F. Snacks such as potato chips should not be consumed around a computer because the greasy residue left on fingertips can easily be transferred to a disk and cause it to malfunction
- G. Hair sprays or other grooming aids should never be used around computers, and even combing hair around a computer can leave residue that will damage equipment or disks
- H. Computers should not be operated in an environment where airborn contaminants can reach them

  (NOTE: This may sometimes be industrial contaminants from manufacturing processes or contaminants produced in food preparation.)
- I. In troubleshooting, it is not uncommon for the environment to be pinpointed as the cause of many computer problems

INFORMATION SHEET

III. **Line protection**

A. Over voltage and voltage transients, surges, and spikes, can easily wipe out data stored in memory or on a disk, or severely damage the entire computer system

(NOTE: In general, transients mean momentary variations in power, but surges refer specifically to damaging increases in power and spikes refer to damaging decreases in power because both conditions contribute to a significant number of system and components failures.)

B. Surge protection devices are available from many manufacturers and are highly recommended for all computers

C. Computers operated in older buildings or buildings that share a power source with a nearby large-usage industry are especially subject to line problems

D. Gliches that appear on disk data are a certain indication that the computer needs line protection

(NOTE: Gliches are basically data that has been garbled to such a degree that it is lost, and sometimes garbled data appears on a monitor screen as erratic shapes that cannot be identified.)

E. In troubleshooting, it is good practice to ask someone who knows about the quality of the power supply the computer is using

IV. **Static control**

A. Static electricity is caused by a lack of humidity in the computer environment

B. Static discharge between a user and a computer can wipe out everything stored in memory and ruin valuable software

(NOTE: Cold weather produces lower humidities because heating systems without humidifiers dry out the air, so static discharge is sometimes a seasonal problem.)

C. The best way to control static discharge is to install a humidifier in the building or the computer room

D. Static discharge can also be controlled by keeping the computer in a room with a tile or hardwood floor

E. A quick solution to the problem of static discharge is to install an anti-static mat under the user's chair and make sure the wire from the mat is attached to a common ground with the computer

INFORMATION SHEET

F. A temporary solution to the problem of static discharge is to spray the area around the computer with an anti-static spray available from most computer stores

G. In troubleshooting, gliches and garbled data usually indicate some problem associated with line troubles or static discharge

V. **Disk head cleaning kits and their uses**

A. There are two types of disk head cleaning kits:

1. Reusable
2. Disposable

B. Procedures for using a reusable disk cleaning kit include:

1. Read the instructions
2. Pour a specified quantity of alcohol-based cleaner onto the disk media
3. Insert the cleaning disk properly into the drive
4. Operate the drive only for the specified length of time

   (CAUTION: The disk cleaning media is very abrasive and operating the drive too long could damage the head because of prolonged contact with the media.)

5. Fill out the chart that comes with the kit so there will be an exact record of how many times the cleaning disk has been used
6. Throw the cleaning disk away when it has been used the number of times recommended by the manufacturer

C. Procedures for using a disposable disk head cleaning kit include:

1. Read the instructions
2. Open the air tight envelope in which the cleaning disk is stored
3. Insert the cleaning disk into the drive
4. Operate the drive only for the specified length of time
5. Throw the cleaning disk away

   (NOTE: Single-use cleaning kits are expensive, but are very convenient for trouble calls because there are no chemicals to worry about and they are very transportable.)

6. Although the cleaning disk is thrown away, the date the head was cleaned should be recorded to assure that it will not inadvertently be cleaned again too soon

INFORMATION SHEET

VI. **Hand tools and their uses**

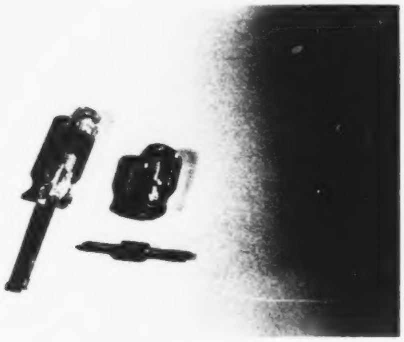
A. Screwdrivers (Figure 1)

1. Both standard and Phillips heads are required
2. Should have enough sizes to fit all screws in a computer or peripheral system
3. Should have insulated handles
4. Should be periodically checked to be sure they are demagnetized

B. Nutdrivers: (Figure 1)

1. Should have a complete set ranging from 3/16" to 3/8"
2. Should have insulated handles
3. Should be periodically checked to be sure they are demagnetized

FIGURE 1



C. Pliers:

1. Both needlenose and slip-joint pliers are required for holding parts
2. Should have insulated handles

D. Extractors and inserters: (Figure 2)

1. Should be professionally designed types (as opposed to something jury-rigged)

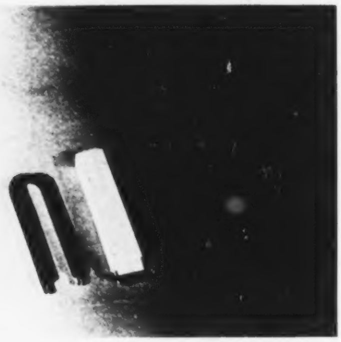
INFORMATION SHEET

2. Should be used only for extracting and inserting chips and for no other purpose

E. IC circuit handling tools: (Figure 2)

1. May be a complete kit
2. May also contain extractors and inserters

FIGURE 2



F. Soldering iron: (Figure 3)

1. Should not exceed 40 watts
2. Should be a low-voltage grounded type, or insulated, or both
3. Should have a tip selection that permits selection of a tip for a specific job

   (NOTE: Small chisel tips are used most frequently, and large tips are seldom used.)

4. Should have a stand or base so it can be conveniently put aside and conveniently reached again

G. Solder: (Figure 3)

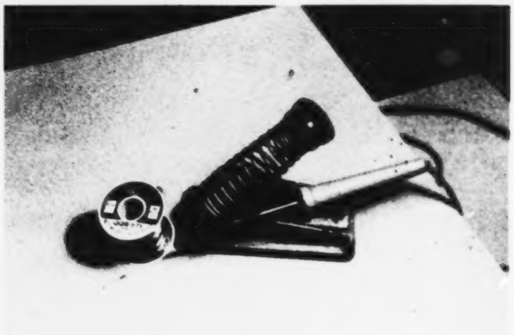
1. Must be only electronic grade solder of good quality

INFORMATION SHEET

2. Should not be used if the core material is unknown

(CAUTION: Never remove or add solder on a computer circuit board without obtaining a release from the manufacturer's authority because manufacturers will not repair boards that have been soldered on and some boards cost in excess of a thousand dollars.)

FIGURE 3



VII. **Test equipment most commonly used**

A. Logic probe

B. VOM's and DVOM's

C. Breakout box

VIII. **How logic probes work**

A. As the name indicates, the pencil-shaped device has a sharp tip with which a technician can probe wires, circuit boards, connectors, and most of the computer circuits

B. Basically, logic probes identify logic levels at given test points, and logic testing may be on one or two types:

1. TTL (transistor transistor logic)

2. CMOS (complementary/symmetry metal oxide semi-conductor)

C. TTL and CMOS are distinctly different logic levels, and a logic probe designed for TTL will not recognize CMOS logic levels

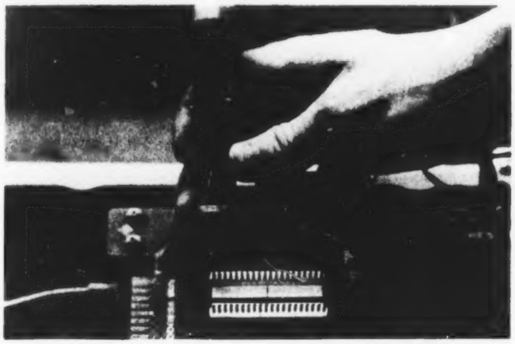
D. When CMOS logic is run at a high level from 3v to 18v, a TTL probe might recognize it, but a TTL probe will not recognize CMOS at a low level

INFORMATION SHEET

E. CMOS probes are recommended, but a probe with a selector switch for either TTL or CMOS is just as good

F. Typically a logic probe is connected to the power supply circuit and derives its power from that circuit (Figure 4)

FIGURE 4



G. Power is required because there is a light on the probe which comes on to indicate logic 1 (high) and the light usually goes off with the logic 0 (low)

H. Some logic probes are designed to give a dim light to indicate that logic is floating between logic 1 and logic 0

(NOTE: Good logic probes have this facility and it is a good function because it eliminates the chance of misreading a 0 or no-light condition which can sometimes be critical, especially in board level work.)

I. A logic probe is used almost exclusively for identifying the 1 and 0 logic presence, but a logic probe does not identify actual voltage

IX. **How VOM's and DVOM's work** (Transparencies 1 and 2)

A. Both VOM's and DVOM's measure:

1. Electrical voltage or pressure
2. Electrical resistance in ohms
3. Electrical current flow

B. The VOM is read from a metering scale on the face of the instrument and the DVOM is read from a digital display that presents the reading as a digit, but both meters accomplish the same objectives, and both are actually three meters contained in one convenient unit

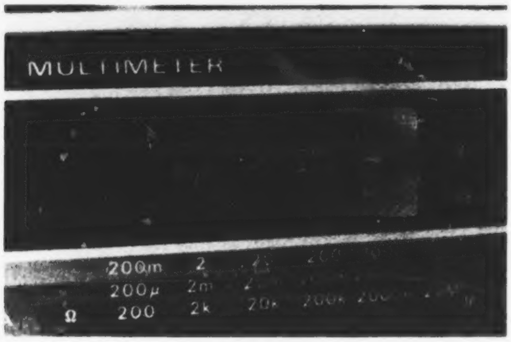
INFORMATION SHEET

C. Most measurements used by board level technicians will require the use of the volt meter to measure voltage and the ohmmeter to measure resistance, but there will seldom be a need to use the current flow meter

D. The voltmeter in the VOM is used to measure electrical voltage (pressure) applied to a specific section of the system or across some particular component WHEN THE SYSTEM IS UNDER POWER (Figure 5)

Example: To identify failure of a system such as the power supply, voltages have to be measured at specific test points

FIGURE 5



E. The ohmmeter in the VOM is used to measure resistance in a circuit or component THAT IS NOT UNDER POWER

(CAUTION: Always remember that the ohm meter has its own power supply, and if it is connected to a circuit that had power applied, it will very likely damage the ohmmeter or at least blow a fuse.)

F. The ohmmeter in the VOM is also used to:

1. Identify subsystems with improper resistances such as shorted printed circuit boards or shorted power supplies

2. Identify system components that have burned out and present completely open or infinite resistance

INFORMATION SHEET

X. **Safety precautions for making voltage measurements**

A. When it is necessary to power up a system to make voltage measurements be especially careful around high voltage sections of the system

1. High voltage AC at the input of the computer

2. High voltage DC around the video display unit and especially around the CRT

B. Certain voltage tests require specific procedures, so always read instructions and follow them precisely to a T

C. Operate the voltmeter in such a way that inadvertently touching adjacent components will not damage the system:

1. Connect the ground lead first

2. Connect the voltage lead second

3. Apply power only after the connections are in place

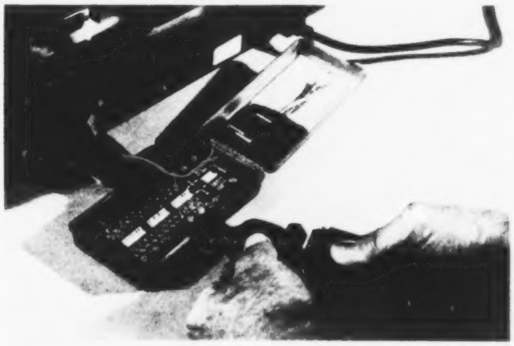
XI. **How a breakout box works** (Figure 6)

A. A breakout box is a circuit tester normally used to check the communications wiring or cable between the serial output of the microcomputer and a peripheral such as a printer or a modem

(NOTE: In some cases, a breakout may also be used to evaluate parallel output.)

B. A breakout box is connected on one side to either the computer or the external device and then the cable is connected to the breakout box to place it between the computer and the external device

FIGURE 6



INFORMATION SHEET

C. Leads from the breakout box are then connected to the wiring in the cable and what is happening to the signals on the cable can be evaluated by observing the presence or absence of light on the LED's housed in the breakout box

(NOTE: Now you can see how the device got its name because it is literally "breaking" signals out of the cable so they can be observed.)

D. Using a breakout box is probably the best way to identify a malfunctioning cable or an improper cable

Example: When an electrical handshaking signal is not being completed between a computer and a printer, the absence of a light on the breakout box will indicate the problem

XII. **Vendor support**

A. Vendors of microcomputer equipment usually provide support for repair technicians with a vendor support telephone number or trouble hotline

B. Vendor support telephones give a technician the chance to discuss a problem with a representative from the manufacturer, someone who probably has an extensive background in troubleshooting

C. Some vendors will go only so deep into a system, and then refer you back to the manufacturer

D. Vendor support telephone numbers and addresses should be known for all pieces of equipment where such support is available

XIII. **Other test equipment and its uses**

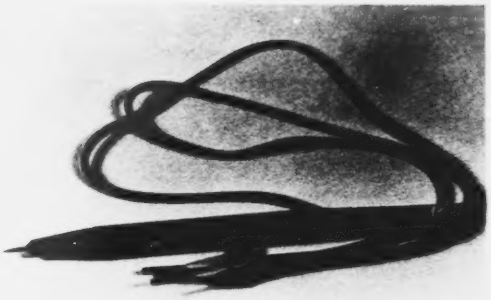
A. Current tracer probe — A noninvasive probe (circuit doesn't have to be opened) capable of identifying current flow and tracing it through a wire, a printed circuit, or through a component

B. Logic pulsar — A probe designed especially to provide short pulses of current high enough to momentarily override the low states of TTL logic so it can be tested without degrading gate performance (Figure 7)

(NOTE: Previous methods of providing current high enough to change TTL logic from low to high state were usually destructive because continuous high current tends to destroy a TTL gate's output transistor, but the pulser works in short pulses, and when used in conjunction with other digital troubleshooting tools, it is an extremely effective tool.)

INFORMATION SHEET

FIGURE 7



C. Logic clip — A device that fits over the top of an IC chip so that small LED's at each of the IC pins lights or does not light to identify the logic level present at each pin on an entire IC (Figure 8)

FIGURE 8

D. Signature analyzer — A device that produces a number or a combination of characters on a display in such a way that they represent the electrical conditions that should appear at a specific circuit junction or node

(NOTE: The signature analyzer will run while the system is operating, and although the signature analyzer does not indicate the nature of the problem, it can isolate the area where the problem is and speeds up troubleshooting time for a fairly low cost.)

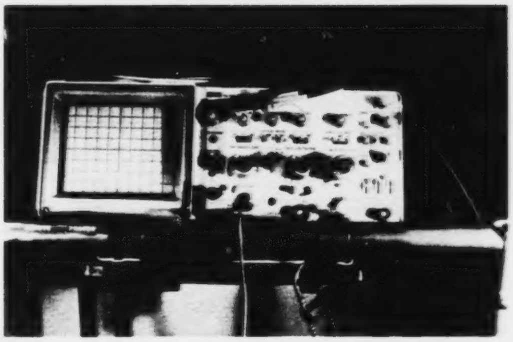
INFORMATION SHEET

E. Oscilloscope — A device with a screen which provides a visual display of an electrical voltage with respect to time or frequency (Figure 9)

Example: Since typical microcomputer systems have timing from two clock signals, the timing between these two waveforms is nearly impossible to evaluate with any instrument other than an oscilliscope

(NOTE: For use with modern microcomputers, an oscilloscope should have a minimum frequency of 60 megahertz, and most manufacturers are now recommending that frequency be extended to 100 megahertz for use with the more sophisticated microcomputers of the future.)

FIGURE 9



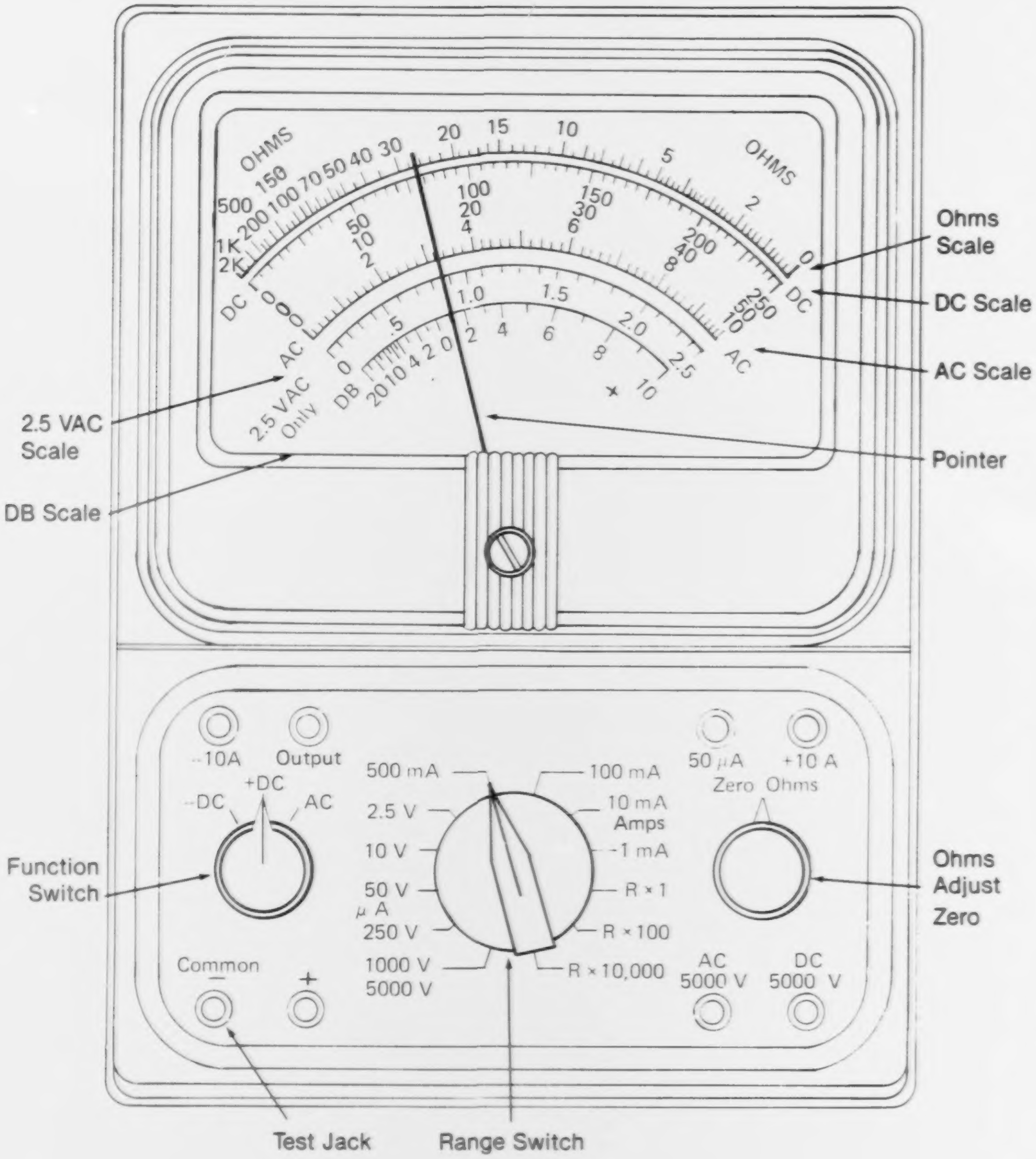
F. Data analyzer — A special form of oscilloscope capable of screening all of the data bus information simultaneously so that data can be evaluated in either a data domain or a time domain sequence on the screen:

1. In the data domain, information will appear as high and low pulses (1's and 0's) on the screen, and since the event that triggers data can be specified, a malfunction can be triggered so data preceding and following the malfunction can be analyzed

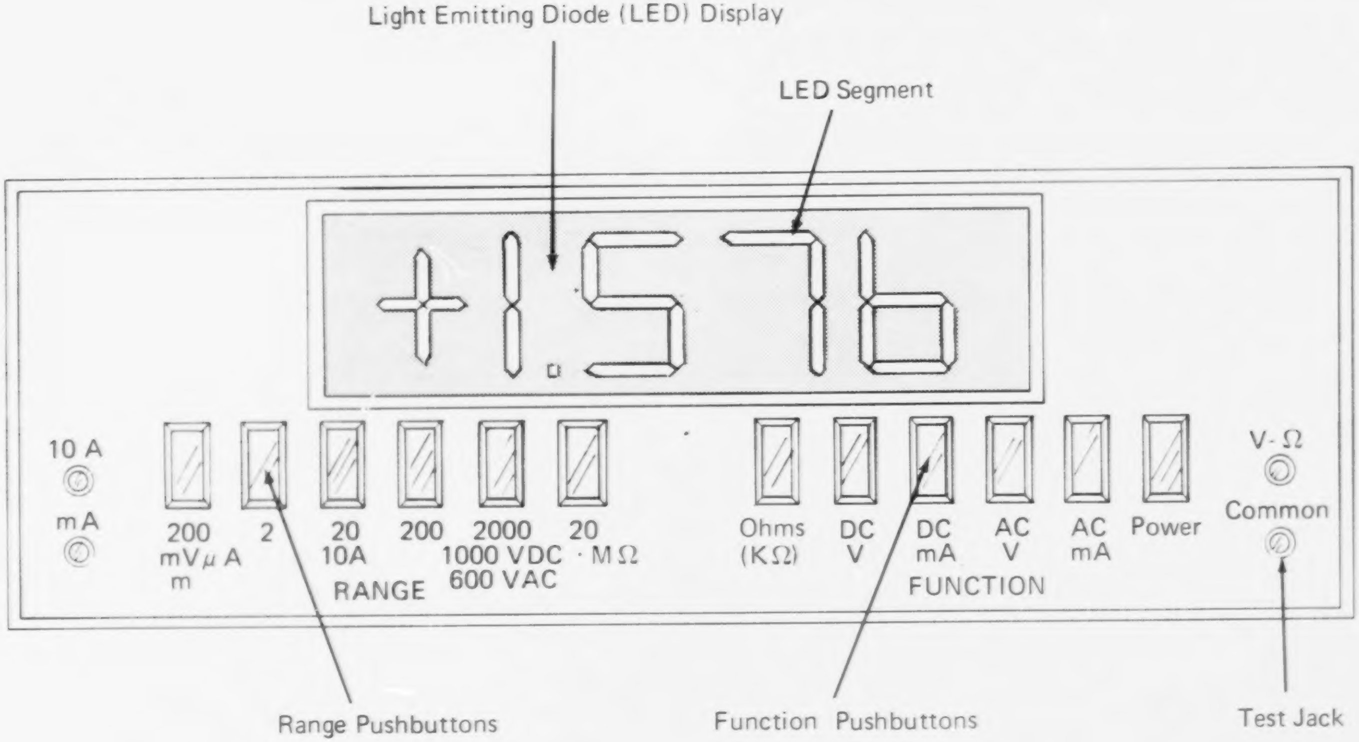
2. In the time domain, electrical pulses on the data lines from the data bus are screened simultaneously as timing waveforms so that timing irregularities before or after a malfunction can be identified

   (NOTE: Data analyzers are expensive, but in some cases, the only way to find certain hardware-software problems because the problems can be observed in real time while the system operates, and it's like having a snapshot of the operation that can be screened and examined at leisure.)

VOM


OHMS
500
150
200 100 70 50 40 30
20 15 10 5 2 0
1K
2K
OHMS
DC
AC
100
20
4
50
10
2
150
30
6
200
40
8
250
50
10
DC
AC
0
.5
1.0
1.5
2.0
2.5
DB
20 10 4 2 0 2 4 6 8 10
2.5 VAC Only
Ohms Scale
DC Scale
AC Scale
2.5 VAC Scale
DB Scale
Pointer
-10A
Output
50 μA
+10 A
Zero Ohms
-DC
+DC
AC
Function Switch
500 mA
2.5 V
10 V
50 V
μA
250 V
1000 V
5000 V
100 mA
10 mA Amps
1 mA
R × 1
R × 100
R × 10,000
Ohms Adjust Zero
Common
−
+
AC 5000 V
DC 5000 V
Test Jack
Range Switch

DVOM


Light Emitting Diode (LED) Display
LED Segment
+1.576
10 A
mA
200 mVμA m
2
20 10A
200
2000 1000 VDC 600 VAC
20 · MΩ
RANGE
Ohms (KΩ)
DC V
DC mA
AC V
AC mA
Power
FUNCTION
V-Ω
Common
Range Pushbuttons
Function Pushbuttons
Test Jack

TOOLS AND EQUIPMENT
UNIT VI

JOB SHEET #1 — CHECK POWER SUPPLY VOLTAGES WITH A DVOM

A. Tools and equipment

1. Microcomputer as selected by instructor
2. Service manual or Computerfacts™ schematic
3. DVOM
4. Hand tools
5. Pencil and paper

B. Procedure

1. Unplug the microcomputer from its power source and turn the microcomputer OFF
2. Remove the microcomputer cover as directed in the service manual
3. Plug the microcomputer into a power source and turn the microcomputer ON
4. Check the service manual or schematic for power supply measurements and measurement points
5. Turn the DVOM ON and place the two leads together to make sure the meter zeros out to indicate it is working properly
6. Set the DVOM for a range that will cover the anticipated voltage measurements

   (NOTE: Check your DVOM because some types have auto range functions and the range setting does not have to be made manually.)

7. Make your first voltage measurement with the following procedure:
   a. Place the red lead on the voltage measurement point
   b. Place the black lead on to a common reference point in the circuit, and this will usually be a chassis ground
   c. Read the digital LED readout and record your findings
8. Repeat the previous procedure for each of the voltage points and record your findings

JOB SHEET #1

9. Disconnect both DVOM leads, then turn the meter OFF

   (NOTE: Develop the habit of disconnecting the leads before turning the meter OFF.)

10. Turn the microcomputer off and disconnect it from the power source

11. Have your instructor check your readings

12. Repeat the procedure as directed for any readings that may have exceeded the plus or minus allowance indicated in the service manual

13. Clean up area and return tools and equipment to proper storage, or prepare for next job sheet as directed by your instructor

TOOLS AND EQUIPMENT
UNIT VI

JOB SHEET #2 — CHECK SYSTEM FUSES WITH A DVOM

A. Tools and equipment

1. Microcomputer as selected by instructor
2. Service manual or Computerfacts™ schematic
3. DVOM
4. Hand tools
5. Pencil and paper
6. Replacement fuses as required

B. Procedure

1. Unplug the microcomputer from its power source and turn the microcomputer OFF
2. Remove the microcomputer cover as directed
3. Locate the system fuses and remove the first one
4. Inspect the fuse visually to see if the resistance element is burned out or shows signs of overheating

   (NOTE: Some fuses are encased in plastic and others have resistance elements that are difficult to evaluate, so the DVOM check is essential in those cases.)
5. Turn the DVOM ON and place the two leads together to make sure the meter zeros out to indicate it is working properly
6. Set the DVOM on the lowest range in the R or Ohm position
7. Place the test leads on each end of the first fuse and look for a reading between zero and ten ohms to indicate a good fuse
8. Replace the fuse as required if the reading indicates infinity (open), which means the fuse is defective
9. Repeat the procedure for any other fuses in the system
10. Turn the DVOM OFF

JOB SHEET #2

11. Have your instructor check your work

12. Replace the cover on the microcomputer and doublecheck to make sure all screws are back in the proper places

13. Clean up area and return tools and equipment to proper storage

TOOLS AND EQUIPMENT
UNIT VI

NAME ______________________

TEST

1. Match the terms on the right with their correct definitions.

   _____a. Any substance that can cut, gouge, or mar the surface of another substance

   _____b. Dust, grease, or any particulate matter present in air, or dirt, grease or impurities on somebody's hand or on tools or equipment in a computer environment

   _____c. A device designed to add controlled amounts of moisture to the air in order to moderate dryness in an indoor space

   _____d. Any company that sells microcomputers or related supplies, devices, or peripherals

   1. Contamination
   2. Vendor
   3. Abrasive
   4. Humidifier

2. Complete the following statements concerning requirements for a healthy computer environment by inserting the word(s) that best completes each statement.

   a. The area in which any computer is used should be as free of ____________ as possible

   b. A computer should not be exposed to excessive ____________, ____________, or ____________

   c. ____________ ____________ should be used to cover all pieces of the computer equipment when they are not in use

   d. ____________ should not be permitted in an area where computers are located

   e. ____________ ____________ or any kinds of liquids that can be spilled should not be consumed around a computer

   f. Snacks such as ____________ ____________ should not be consumed around a computer because the greasy residue left on fingertips can easily be transferred to a disk and cause it to malfunction

   g. ____________ ____________ or other grooming aids should never be used around computers, and even combing hair around a computer can leave residue that will damage equipment or disks

TEST

h. Computers should not be operated in an environment where __________ contaminants can reach them

i. In troubleshooting, it is not uncommon for the __________ to be pinpointed as the cause of many computer problems

3. Select true statements concerning line protection by placing an "X" in the appropriate blanks.

_____a. Over voltage and voltage transients, surges, and spikes, can easily wipe out data stored in memory or on a disk, or severely damage the entire computer system

_____b. Surge protection devices are available from many manufacturers and are highly recommended for all computers

_____c. Computers operated in older buildings or buildings that share a power source with a nearby large-usage industry are seldom subject to line problems, but should still have protection

_____d. Gliches that appear on disk data are a certain indication that the computer needs line protection

_____e. In troubleshooting, it is good practice to ask someone who knows about the quality of the power supply the computer is using

4. Complete the following statements concerning static control by inserting the word(s) that best completes each statement.

a. Static electricity is caused by a lack of __________ in the computer environment

b. Static discharge between a user and a computer can wipe out everything stored in __________ and ruin valuable __________

c. The best way to control static discharge is to install a __________ in the building or the computer room

d. Static discharge can also be controlled by keeping the computer in a room with a __________ or __________ floor

e. A quick solution to the problem of static discharge is to install an __________-__________ __________ under the user's chair and make sure the wire from the __________ is attached to a common ground with the computer

f. A temporary solution to the problem of static discharge is to __________ the area around the computer with an anti-static __________ available from most computer stores

g. In troubleshooting, __________ and __________ data usually indicate some problem associated with line troubles or static discharge

TEST

5. Complete the following statements concerning disk head cleaning kits and their uses by inserting the word(s) that best complete each statement.

   a. There are basically two types of disk head cleaning kits:

      1) ____________

      2) ____________

   b. Procedures for using a reusable disk cleaning kit include:

      1) ____________ the instructions

      2) ____________ a specified quantity of alcohol-based cleaner onto the disk media

      3) Insert the ____________ ____________ properly into the drive

      4) Operate the drive only for the ____________ length of time

      5) Fill out the ____________ that comes with the kit so there will be an exact ____________ of how many times the cleaning disk has been used

      6) ____________ ____________ ____________ ____________ ____________ when it has been used the number of times recommended by the manufacturer

   c. Procedures for using a disposable disk head cleaning kit

      1) ____________ the instructions

      2) Open the ____________ ____________ ____________ in which the cleaning disk is stored

      3) Insert the ____________ ____________ into the drive

      4) Operate the drive only for the ____________ length of time

      5) ____________ ____________ ____________ ____________ away

      6) Although the cleaning disk is thrown away, the date the head was cleaned should be ____________ to assure that it will not inadvertently be cleaned again too soon

TEST

6. Complete the following statements concerning hand tools and their uses by inserting the word(s) that best completes each statement.

   a. Screwdrivers:

      1) Both standard and ____________ heads are required

      2) Should have enough ____________ to fit all screws in a computer or peripheral system

      3) Should have ____________ handles

      4) Should be periodically checked to be sure they are ____________

   b. Nutdrivers:

      1) Should have a ____________ ____________ ranging from 3/16" to 3/8"

      2) Should have ____________ handles

      3) Should be periodically checked to be sure they are ____________

   c. Pliers:

      1) Both ____________ and ____________ pliers are required for holding parts

      2) Should have ____________ handles

   d. Extractors and inserters:

      1) Should be ____________ designed types (as opposed to something jury-rigged)

      2) Should be used only for ____________ and ____________ chips and for no other purpose

   e. IC circuit handling tools:

      1) May be a complete ____________

      2) May also contain ____________ and ____________

   f. Soldering iron:

      1) Should not exceed ____________ watts

      2) Should be a low-voltage grounded type, or insulated, or ____________

TEST

3) Should have a ____________ ____________ that permits selection of a tip for a specific job

4) Should have a ____________ or ____________ so it can be conveniently put aside and conveniently reached again

g. Solder

1) Must be only ____________ grade solder of good quality

2) Should not be used if the core materials ____________

7. List test equipment most commonly used.

a. ____

b. ____

c. ____

8. Select true statements concerning how logic probes work by placing an "X" in the appropriate blanks.

_____a. As the name indicates the pencil-shaped device has a sharp tip with which a technician can probe wires, circuit boards, connectors, and most of the computer circuits

_____b. Basically, logic probes identify logic levels at given test points, and logic testing may be on one or two types:

1) TTL

2) CMOS

_____c. TTL and CMOS are distinctly different logic levels, but a logic probe designed for TTL will recognize CMOS logic levels

_____d. When CMOS logic is run at a high level from 3v to 18v, a TTL probe might recognize it, but a TTL probe will not recognize CMOS at a low level

_____e. TTL probes are recommended, but a probe with a selector switch for either TTL or CMOS is just as good

_____f. Typically a logic probe is connected to the power supply circuit and derives its power from that circuit

_____g. Power is required because there is a light on the probe which comes on to indicate logic 1 and the light usually goes off with the logic 0

TEST

_____h. Some logic probes are designed to give a dim light to indicate that logic is floating between logic 1 and logic 0

_____i. A logic probe is used almost exclusively for identifying the 1 and 0 logic presence, but a logic probe also identifies actual voltage

9. Complete the following statements concerning how VOM's and DVOM's work by inserting the word(s) that best completes each statement.

   a. Both VOM's and DVOM's measure:

      1) Electrical ____________ or pressure

      2) Electrical ____________ in ohms

      3) Electrical ____________ ____________

   b. The VOM is read from a metering scale on the face of the instrument and the DVOM is read from a digital display that presents the reading as a digit, but both meters accomplish the same objectives, and both are actually ____________ meters contained in one convenient unit

   c. Most measurements used by board level technicians will require the use of the voltmeter to measure voltage and the ohmmeter to measure resistance, but there will seldom be a need to use the ____________ ____________ meter

   d. The voltmeter in the VOM is used to measure electrical voltage applied to a specific section of the system or across some particular component WHEN THE SYSTEM IS ____________ ____________

   e. The ohmmeter in the VOM is used to measure resistance in a circuit or component THAT IS ____________ ____________ ____________

   f. The ohmmeter in the VOM is also used to:

      1) Identify subsystems with improper ____________ such as shorted printed circuit boards or shorted power supplies

      2) Identify system components that have ____________ ____________ and present completely open or infinite resistance

10. Complete the following list of safety precautions for making voltage measurements by inserting the word(s) that best completes each statement.

   a. When it is necessary to power up a system to make voltage measurements be especially careful around high voltage sections of the system

      1) High voltage ____________ at the ____________ of the computer

      2) High voltage ____________ around the ____________ ____________ unit and especially around the ____________

TEST

b. Certain voltage tests require ____________ procedures, so always read instructions and follow them precisely

c. Operate the voltmeter in such a way that inadvertently touching adjacent components will not damage the system:

1) Connect the ____________ lead first

2) Connect the ____________ lead second

3) Apply power only ____________ ____________ ____________ ____________ ____________

11. Select true statements concerning how a breakout box works by placing an "X" in the appropriate blanks.

_____a. A breakout box is a circuit tester normally used to check the communications wiring or cable between the serial output of the microcomputer and a peripheral such as a printer or a modem

_____b. A breakout box is connected on one side to either the computer or the external device and then the cable is connected to the breakout box to place it between the computer and the external device

_____c. Leads from the breakout box are then connected to the wiring in the cable and what is happening to the signals on the cable can be evaluated by observing the presence or absence of light on the LED's housed in the breakout box

_____d. Using a breakout box is probably the best way to identify a malfunctioning cable or an improper cable

12. Select true statements concerning vendor support by placing an "X" in the appropriate blanks.

_____a. Vendors of microcomputer equipment usually provide support for repair technicians with a vendor support telephone number or trouble hotline

_____b. Vendor support telephones give a technician the chance to discuss a problem with a representative from the manufacturer, someone who probably has an extensive background in troubleshooting

_____c. Most vendors know all about so many systems they never have to refer you to a manufacturer

_____d. Vendor support telephone numbers and addresses should be known for all pieces of equipment where such support is available

TEST

13. Match other test equipment with its uses.

_____a. A noninvasive probe (circuit doesn't have to be opened) capable of identifying current flow and tracing it through a wire, a printed circuit, or through a component

_____b. A probe designed especially to provide short pulses of current high enough to momentarily override the low states of TTL logic so it can be tested without degrading gate performance

_____c. A device that fits over the top of an IC chip so that small LED's at each of the IC pins lights or does not light to identify the logic level present at each pin on an entire IC

_____d. A device that produces a number or a combination of characters on a display in such a way that they represent the electrical conditions that should appear at a specific circuit junction or node

_____e. A device with a screen which provides a visual display of an electrical voltage with respect to time or frequency

_____f. A special form of oscilloscope capable of screening all of the data bus information simultaneously so that data can be evaluated in either a data domain or a time domain sequence on the screen

1. Logic clip
2. Data analyzer
3. Current tracer probe
4. Signature analyzer
5. Logic pulsar
6. Oscilloscope

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

14. Demonstrate the ability to:

    a. Check power supply voltages with a DVOM. (Job Sheet #1)

    b. Check system fuses with a DVOM. (Job Sheet #2)

TOOLS AND EQUIPMENT
UNIT VI

ANSWERS TO TEST

1. a. 3
   b. 1
   c. 4
   d. 2

2. a. Contamination
   b. Heat, cold, humidity
   c. Dust covers
   d. Smoking
   e. Soft drinks
   f. Potato chips
   g. Hair sprays
   h. Airborn
   i. Environment

3. a,b,d,e

4. a. Humidity
   b. Memory, software
   c. Humidifier
   d. Tile, hardwood
   e. Anti-static mat, mat
   f. Spray, spray
   g. Gliches, garbled

5. a. 1) Reusable
      2) Disposable

   b. 1) Read
      2) Pour
      3) Cleaning disk
      4) Specified
      5) Chart, record
      6) Throw the cleaning disk away

   c. 1) Read
      2) Air tight envelope
      3) Cleaning disk
      4) Specified
      5) Throw the cleaning disk
      6) Recorded

6. a. 1) Phillips
      2) Sizes
      3) Insulated
      4) Demagnetized

ANSWERS TO TEST

- b.
  - 1) Complete set
  - 2) Insulated
  - 3) Demagnetized
- c.
  - 1) Needlenose, slip-joint
  - 2) Insulated
- d.
  - 1) Professionally
  - 2) Extracting, inserting
- e.
  - 1) Kit
  - 2) Extractors, inserters
- f.
  - 1) 40
  - 2) Both
  - 3) Tip selection
  - 4) Stand, base
- g.
  - 1) Electronic
  - 2) Unknown

7.
  - a. Logic probe
  - b. VOM's and DVOM's
  - c. Breakout box

  (NOTE: May be in any order.)

8. a,b,d,f,g,h

9.
  - a.
    - 1) Voltage
    - 2) Resistance
    - 3) Current flow
  - b. Three
  - c. Current flow
  - d. UNDER POWER
  - e. NOT UNDER POWER
  - f.
    - 1) Resistance
    - 2) Burned out

10.
  - a.
    - 1) AC, input
    - 2) DC, video display, CRT
  - b. Specific
  - c.
    - 1) Ground
    - 2) Voltage
    - 3) After the connections are in place

11. a,b,c,d

ANSWERS TO TEST

12. a,b,d

13. a. 3
    b. 5
    c. 1
    d. 4
    e. 6
    f. 2

14. Competencies evaluated according to procedures outlined in the job sheets.

PERIPHERALS
UNIT VII

UNIT OBJECTIVE

After completion of this unit, the student should be able to list types of printers, disk drives, and modems, and discuss the procedures used for connecting peripherals to a microcomputer. The student should also be able to replace a ribbon and a print head on a dot-matrix printer and hook up disk drives to a microcomputer. These competencies will be evidenced by correctly completing the procedures outlined in the assignment and job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to peripherals with their correct definitions.
2. Complete statements concerning modes for printer interfacing.
3. Select true statements concerning ASCII codes and their meanings.
4. Complete statements concerning dot matrix printer operations.
5. Select true statements concerning ink jet printer operations.
6. Select true statements concerning laser printer operations.
7. Complete statements concerning letter quality printer operations.
8. Differentiate between common electrical levels used for sending serial information.
9. Complete statements concerning BAUD rates and printer switch setup.
10. Complete statements concerning BAUD rates.
11. Select statements concerning printer handshaking protocol.
12. Solve a problem concerning cable configurations for information transmission.
13. Select true statements concerning modems and how they work.
14. Complete statements concerning characteristics of floppy disk drives.
15. Select true statements concerning media for floppy disk drives.
16. Complete statements concerning hard disk drives.

OBJECTIVE SHEET

17. Complete statements concerning classifications of computer terminals.
18. Select true statements concerning microcomputer cassette recorders.
19. Complete statements concerning memory expansion with RAM cards.
20. Complete statements concerning special cards and their uses.
21. Select true statements concerning how networks operate.
22. Complete statements concerning hardware and software requirements for networking.
23. Match graphics devices with their characteristics.
24. Select true statements concerning characteristics of CRT-based video displays.
25. Complete statements concerning other types of video displays.
26. Select true statements concerning switch boxes and their uses.
27. Diagram the interface between a microcomputer and a parallel printer. (Assignment Sheet #1)
28. Diagram the interface between a microcomputer and a serial printer. (Assignment Sheet #2)
29. Demonstrate the ability to:
    a. Replace the ribbon and print head on a dot-matrix printer. (Job Sheet #1)
    b. Hook up disk drives to an Apple microcomputer. (Job Sheet #2)

PERIPHERALS
UNIT VII

SUGGESTED ACTIVITIES

A. Provide student with objective sheet.

B. Provide student with information, assignment, and job sheets.

C. Make transparencies.

D. Discuss unit and specific objectives.

E. Discuss information sheet and assignment sheets.

F. Discuss and demonstrate the procedures outlined in the job sheet.

G. Arrange for the class to visit a bank or other business that uses some form of computer networking, and have students report on the trip and what they learned from it.

H. Invite an area service technician who specializes in repairing printers or disk drives (or both) to talk to the class about the importance of peripheral repair and its future for the technicians who may want to specialize in that area, and encourage students interested in that area to review MAVCC's *Microcomputer Peripheral Service Technician*, the third book in this series.

I. Demonstrate the types of cables used in a printer/microcomputer hookup, and relate the demonstration to the PowerType serial and parallel interfaces shown in the transparencies.

J. Give test.

CONTENTS OF THIS UNIT

A. Objective sheet

B. Information sheet

C. Transparency masters

  1. TM 1 — PowerType Parallel Interface
  2. TM 2 — PowerType Parallel Interface (Continued)
  3. TM 3 — PowerType Serial Interface
  4. TM 4 — PowerType Serial Interface (Continued)
  5. TM 5 — ASCII Conversion Chart (0-9)

CONTENTS OF THIS UNIT

D. Assignment sheets

   1. Assignment Sheet #1 — Diagram the Interface Between a Microcomputer and a Parallel Printer

   2. Assignment Sheet #2 — Diagram the Interface Between a Microcomputer and a Serial Printer

E. Job sheets

   1. Job Sheet #1 — Replace the Ribbon and Print Head on a Dot-Matrix Printer

   2. Job Sheet #2 — Hook Up Disk Drives to an Apple Microcomputer

F. Test

G. Answers to test

REFERENCES USED IN DEVELOPING THIS UNIT

A. *Daisywheel Printer PowerType Technical Manual.* New York, NY 10166: Star Micronics, Inc., 1984.

B. *Microline 92 Dot-Matrix Printer (Standard Mode) Maintenance Manual.* Mt. Laurel, NJ 08054: OKI Electric Industry Company, Ltd., 1984.

C. *Apple II Disk II Installation Manual.* Cupertino, CA 95014: Apple Computer, Inc., 1982.

D. *Apple II Parallel Interface Card Installation and Operating Manual.* Cupertino, CA 95014: Apple Computer, Inc., 1982.

PERIPHERALS
UNIT VII

INFORMATION SHEET

I. **Terms and definitions**

A. ASCII — American Standard Code for Information Interchange, the seven-bit binary code used to represent letters and numbers

B. BAUD — Short for Baudot, a code for rating the speed at which information is sent and received

C. Configuration — The way the components in a microcomputer system are arranged to interact with each other and with the system

D. DIP — Dual in-line package, the standard hardware form used for housing integrated circuits

E. DIP switches — Small switches built into a DIP so that the function of the IC can be modified without requiring a hardware change

F. Interface — Cables and connectors or any devices which make it possible for two devices to exchange signals so controlled that the devices can "talk" to each other

II. **Modes for printer interfacing**

A. Printer interfacing is done in either:

1. The parallel mode (Transparencies 1 and 2)

2. The serial mode (Transparencies 3 and 4)

B. When information is sent to a printer in parallel mode, an entire word is sent in one timing cycle

C. When information is sent to a printer in serial mode, it goes one bit at a time as an ASCII word in one timing cycle

(NOTE: ASCII code serves as the standard by which bits are arranged so that one piece of equipment can communicate with another; see Transparency 1.)

III. **ASCII codes and what they mean** (Transparency 5)

A. ASCII codes are seven-bit binary numbers for:

1. Lowercase letters of the alphabet

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2. Uppercase letters of the alphabet

3. Punctuation and graphics marks

4. Math and scientific symbols

5. Control functions for communications

B. ASCII codes were designed originally for teletype equipment, and although many ASCI codes do not apply to microcomputer use, they are used in both printer and terminal control

(NOTE: Transparency 5 gives an example of some of the ASCII codes that are used in printer control.)

IV. **Dot-matrix printer operations**

A. Because they produce both alphanumeric characters and graphics too, dot matrix printers are the ones most frequently used and the ones most often repaired

B. A dot-matrix printer works with a print head that is a package of solenoids with wires attached to them

C. When a solenoid or group of solenoids is activated, the wires push forward from the head, make contact with an inked ribbon, and force the ribbon to contact the paper and leave an image formed from closely-spaced dots

D. Because the wires are placed so close together, the space between the dots is not highly visible, and some dot matrix printers go back over the area with the head slightly offset to fill in space between dots and create a better looking character

E. As dot-matrix printers have improved, the heads use a single vertical row of wires and software is used to control spacing in a horizontal axis so that additional wires can be used to improve appearance

(NOTE: Heads in early dot-matrix printers formed the entire letter at once, but the new heads permit the use of descenders, the below-the-line parts of letters like y and q, and this makes the printing look better.)

F. Since dot-matrix printers can produce both characters and graphics, they will continue to be popular, and knowing how they work will provide a good background for troubleshooting

V. **Ink jet printer operations**

A. Ink jet printers work on the same principle as a dot matrix printer except that the wires in the head are actually miniature tubes that transport ink

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B. Ink jet printers eliminate the need for a ribbon, but bring a new maintenance problem of keeping the ink jets clean

(NOTE: It appears, however, that ink jet heads will be a low cost replaceable type, so as the ink jet printer catches on and improves, replacing a head may be cheaper than removing and cleaning one.)

C. Because of their almost silent operating characteristics, ink jet printers promise to become popular and will require a repair technician to know how to maintain and repair them

VI. **Laser printer operations**

A. Laser printers deposit a charge on the paper surface and the image is transferred via the charge, a procedure much like the one used in standard office copying machines

B. Quality from a laser printer is so good that some off-set printing will not compare with it, but laser printers are very expensive, their use is limited, and their maintenance and repair requires highly specialized training

VII. **Letter quality printer operations**

A. Letter quality printers work a good deal like typewriters, and many typewriter manufacturers are simply interfacing their electronic typewriters to computers and selling them as printers

B. Letter quality printers use some kind of movable characters on devices such as a daisy wheel, print cylinder, or print ball, and as the name suggests, they produce letter quality characters, but will not produce graphics

C. The typewriter-like construction of letter quality printers requires more mechanical maintenance and mechanical repair than dot-matrix printers

VIII. **Common electrical levels used for sending serial information**

A. RS-232C — A standard which uses voltage levels to represent bits in ranges of plus or minus 5 volts to plus or minus 15 volts

B. TTY (Teletype) — A defacto standard which uses current levels to represent bits so that a 0 or low bit is 0 to 3 mA and a high bit or 1 is from 15 to 20 mA

(NOTE: The TTY level is sometimes called the 20 mA loop, and there are new interface standards already sanctioned by such groups as IEEE, Institute of Electrical and Electronic Engineers, and EIA, Electronic Industry Association; since the area of interfacing is a rapidly changing one, these new standards should bring new interface connections for equipment of the future, and marks another area where a repair technician will have to keep up to date.)

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IX. **BAUD rates and printer switch setup**

A. Most printers have multiple BAUD rate capabilities and the positioning of BAUD rate switches will be pictured in the microcomputer user's manual

B. The objective is to match the BAUD rate of the printer with that of the computer because they should be the same

C. When a customer has a printer, especially a new printer that does not work, it's always wise to check BAUD rates and switch settings because the problem might be quickly solved by resetting a switch

X. **BAUD rates**

A. BAUD rate is the rate at which serial information is sent or the rate at which "bits" of information is sent

B. An entire ASCII character is sent in a time period that prescribes the BAUD rate of the machine

C. A rule of thumb is that the time frame gets longer as the BAUD rate number gets smaller

Example: 300 BAUD will send 10 bits of information per character in 33 ⅓ milliseconds, 150 BAUD will send 10 bits of information per character in 66 ⅔ milliseconds, and original teletype equipment at 110 BAUD sent 11 bits of information per character in 100 milliseconds

D. BAUD rates on modern video equipment can run as high as 4,800 BAUD, but when extremely high BAUD rates are used with printers, information must be stored in memory in the printer so that the printer can work at its highest rate possible yet not exceed the limitations of its mechanical capabilities

XI. **Printer handshaking protocol**

A. When a printer with a serial interface has no printer (buffer) memory, then the rate of exchange between the microcomputer and the printer must be controlled through a handshaking protocol

B. Handshaking protocol is typically used with a serial printer interface and

1. Enables the computer to recognize when the printer is free to accept information

2. Enables the computer to change one of its handshake lines to indicate that information has been sent to the printer

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3. At the end of a transmitted character, it will enable the printer to change one of its handshake lines to indicate acceptance which in turn will tell the computer to send the next character

C. A minimum of two handshake lines is necessary, but some systems have more

XII. **Cable configurations for information transmission**

A. DCE — Data communications equipment may start, maintain, or end a data transmission and computers fall in this category

B. DTE — Data terminal equipment serves as a data source and terminals and most peripherals fall in this category

C. The general rule for working with cables that connect DCE or DTE equipment is to always connect DTE to DCE, but never connect two like pieces of equipment together

D. Another general rule about DCE and DTE connections is that DCE connectors are usually female and DTE connectors are usually male

XIII. **Modems and how they work**

A. Modems are always attached to a serial connection on a computer because a modem has no way of handling information in a parallel mode

B. Modem BAUD rates must agree with the computer, and switch settings are similar to those used with printers

C. Switch settings may also be used on modems to satisfy handshaking requirements

D. Modems used with microcomputers must also have appropriate software so the micro can generate information and protocols appropriate to the serial signal handling in the modem

E. Modems do not pose big problems for repair technicians because much of a modem is FCC regulated to a point where they cannot be opened by unauthorized persons, and little can be done with a modem

XIV. **Characteristics of floppy disk drives**

A. Mechanical varieties:

1. Single height

2. Half height

(NOTE: Half height disk drives permit installation of two drives or twin drives in one space.)

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B. Typical disk drive sizes

1. 5 1/4" — Most common

2. 8" — Used with some business systems and can still be purchased as external drive for many systems

   (NOTE: In some cases, the circuitry of a 5 1/4" drive will also serve an 8" drive.)

3. 3 1/2" — These come in hard plastic cases that make them look like cassettes, but they're floppies, can store much more information than a standard 5 1/4" floppy, and are appearing in more and more systems

XV. **Media for floppy disk drives**

A. Media for floppy disk drives may be:

1. Single or double sided

2. Single or double density

B. Media requirements vary from system to system, but it is very important that the media combination recommended for the floppy drive be used with that drive

C. In general, double-density floppies have a thicker oxide coating, must meet high quality control standards, and can simply store more information than single-density floppies

(NOTE: Double-density floppies should work even on a system that has single-density disk drives, and trouble with data dropping out of a floppy disk can sometimes be traced to the use of bad quality single-density floppies that have poor oxide coatings which cause tiny bits of oxide to drop off the disk or make the disk highly subject to scratching.)

D. A single-sided floppy may work in a double-sided drive, but this is strictly a hit-or-miss situation because although the second side of a single-sided floppy has an oxide coating, the oxide has not been finished or tested like the first side

E. When floppy disk drives are operating properly but problems with data loss still occur, look for line problems or improper media

XVI. **Hard disk drives**

A. When working with a hard disk drive, there are some important items to remember:

1. Hard disk drives cost about three to five times as much as floppy disk drives

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2. Hard disk drives are constructed entirely different from floppy disk drives

3. Hard disk drives require a separate and different controller card in the microcomputer

B. A hard disk drive is a sealed system:

   1. The media is a hard metal platter coated with oxide

   2. The read/write head rides on a cushion of air or gas and does not make contact with the oxide surface of the media

   3. Any hard disk system with removable media means that when the media is removed, the read/write head is also removed with it

C. Since it's economically sensible for a microcomputer system to have only one hard disk, a backup procedure is required

   1. Backup can be made on floppy disks, but it would take about 40 floppies to handle the 10 megabytes a hard disk might contain, so this kind of backup is time consuming

   2. More modern backup systems use high-speed tape cartridges that can transfer in less than 30 seconds what it might take half a day to transfer onto floppies

D. For customers who require hard drives added to a microcomputer system, it can be done if the system has card slots or special provisions for external drive applications

XVII. **Classifications of computer terminals**

A. Intelligent (smart) — A terminal with its own computer on board so a user can program as well as send and receive information

B. Nonintelligent (dumb) — A terminal capable of sending and receiving, but one with no computing capability

C. Printing — A terminal that is essentially a printer with a keyboard, or receives information as hard copy on the printer, but it has no video

D. Video — A terminal that cannot make hard copies of information received or sent, but will screen information on a video display and send it or receive information from a remote source and display it on the screen

(NOTE: Video terminals are much more common than printing terminals, and if they are intelligent terminals, they usually have editing capabilities.)

E. Terminals are often used in minicomputer systems, but are also being used in large microcomputer systems

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F. Terminals for a microcomputer system require proper software and normal serial communications

(NOTE: In other words, essential components in a video terminal are the same as in a keyboard and video display: keyboard, keyboard encoder, CRT with appropriate video driver, power supply, and a communications card to put the terminal "on line" with the main systems.)

XVIII. **Microcomputer cassette recorders**

A. Cassette recorders used with microcomputers are similar to those used for everyday audio recording and playback except that they have been modified so that they can be started, stopped, and sometimes backed up by computer commands

(NOTE: Although these cassette systems are designed for microcomputers, similar cassette systems have been used for many years with stenographic equipment.)

B. Cassette recorders used with microcomputers require high-quality tape and in cases where data is critical, digital tapes are usually required

(NOTE: These quality tapes are usually shorter, and available in both audio tape and cassette.)

C. Normally, these cassette recorders are serviced as standard cassette recorders are, mostly by cleaning and aligning recording and playback heads

XIX. **Memory expansion with RAM cards**

A. RAM disk or RAM drive are two other names given to the large RAM card sometimes added to a microcomputer system to increase memory and programming speed

Example: If a user wanted to increase memory to 512 K and normal floppy disk memory for the system was 320 or 360 K per disk, then the amount of information stored on the two disks could easily be stored in RAM memory, and the info stored in the expansion RAM can be manipulated by the computer much faster than information stored on a floppy

B. These devices are also called battery-backed on-board RAM's because they need battery backup power to keep from losing the contents of RAM when power is turned off

C. Once data manipulation has been completed in the RAM drive, the data is normally sent from the RAM back to a floppy for permanent storage

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XX. **Special cards and their uses**

A. Multi-purpose cards contain a number of features on one printed circuit board

1. May contain either a serial or parallel port or both

2. May have real time and date functions, frequently with battery backup

3. Some may also contain memory in the form of ROM or with program capabilities in a RAM disk (previously outlined)

B. Because of their special features, multi-purpose cards are the most popular with users

C. Single purpose cards are inserted in a microcomputer to perform a given function

1. On command, an EPROM chip will accept information stored in memory, store it, and save it even after power is turned off

2. The EPROM chip can be reprogrammed after erasing it with an ultraviolet light box

3. Special cards are frequently required to drive a mouse, a graphics tablet, or a light pen

4. Special cards are also used as floppy and hard disk controllers

5. Special cards also serve as industrial controllers for operating equipment external to the computer, items such as robotic arms

6. Networking cards provide communications and protocols for getting a microcomputer "on line" with a network

XXI. **How networks operate**

A. Computer networks pool hardware and software resources in such a way that a microcomputer user can not only exchange information, but actually use hardware and software features of other computers in the system

B. LAN's (local area networks) have become popular among industries because a number of small microcomputers using a LAN could communicate with one large, hard storage disk or use one expensive laser printer

(NOTE: This pooling of resources makes expensive features available to every microcomputer user, and networks, especially LAN's promise to grow in number.)

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XXII. **Hardware and software requirements for networking**

A. Special hardware is required to attach the computer to the network cable

1. The hardware, simply speaking, takes the normal computer output and changes it into a high-speed communications form

2. Hardware also establishes the electrical protocols used by the system to determine which computer is in control at a given time

B. Special software is required, and must be compatible with the LAN hardware because:

1. Software protocols control procedures for getting "on" and "off" the network

2. Software protocols also control procedure for requesting use of certain features of the system

C. Some networks do not require special hardware or software because they use modems to gain access to telephone equipment which links network participants together

Example: The SOURCE

XXIII. **Graphics devices and their characteristics**

A. The mouse — Essentially an electromechanical or electroptical device so connected to a computer that a user can move it on a flat surface to generate a duplicate cursor movement on the video display

(NOTE: The mouse may also contain appropriate software and buttons which can activate special applications such as anchoring a feature on a screen, moving it, stretching it, or other graphics manipulations that make it popular for CAD [computer-aided drafting] and CAE [computer-aided engineering].)

B. Light pen — A hand-held device that is placed on the screen of the video display so that when the light of the display crosses the pen, it causes the X Y coordinates of the screen location to be placed into memory

C. Graphic pads and touch tablets — Use X and Y coordinates in the hardware to represent some feature stored in ROM, and when the coordinates are activated by a stylus, the information is transferred into RAM

(NOTE: Graphic pads are commonly used in CAD where lines, intersections, curves, arcs, circles, and even electronic component symbols such as resistors and capacitors can be stored, and an operator can pick up lines or symbols with the stylus in the order of their orientation, and the computer will connect them all and complete the drawing.)

INFORMATION SHEET

XXIV. Characteristics of CRT-based video displays

A. Displays are classified according to color, resolution, or both

B. Resolution is a way in which the number of points on a video display are referenced in both the horizontal and vertical directions, and the higher the number of points, the higher the resolution

C. Monochrome or single color displays may be black and white, green, amber, or almost any color, and most monochrome video displays are high resolution displays

D. Because they are high resolution, monochrome displays require a monochrome driver card capable of producing the resolution desired on the screen

E. A monochrome driver card may or may not produce an output that gives a resolution as high as the video display is capable of

F. An RGB display is the equivalent of a TV monitor, but the resolution is much higher

G. An RGB display does require a RGB driver card and will not run off a monochrome driver card

H. To drive a TV set for use as a video display requires "composite" driver card or an RGB drive card that will also handle a composite signal

I. Some graphics cards are capable of driving all three types of video signals, but these cards are very expensive

J. Since most TV sets accept RF input only, an RF adapter is required for the computer to work with a normal TV set

(NOTE: If the TV has a video input jack, the RF adapter is not needed, and some newer TV's offer a video/RF option so the set can be used as a TV or used as a computer monitor by simply flipping a switch.)

XXV. Other types of video displays

A. Some special purpose video displays are not CRT type displays

B. When a computer is required to display only alphanumeric characters, then character-oriented displays such as LED's and LCD's can be used

C. Seven-segment LED's and LCD's used in character displays can be driven off the parallel peripheral chip and controlled by machine language software

D. Another LCD use is in the new, large flat-screen display in some of the new portable computers, where the flat profile of the LCD can be neatly folded into the computer to create a modern-looking, low-profile piece of equipment

E. Large screen LCD's require driver circuitry similar to CRT operation

INFORMATION SHEET

XXVI. **Switch boxes and their uses**

A. Switch boxes are handy devices that are frequently used to connect two microcomputers to one printer

B. Switch boxes are also used to switch parallel and serial cables from the output of a computer

C. The switching arrangement is controlled by the arrangement of cable connections in the switch box

D. Switch boxes are relatively inexpensive, and when one malfunctions, it is usually replaced, not repaired

PowerType Parallel Interface

Parallel interface connector pin No.	Signal name	I/O Classification	Description	CN1 pin No.
1	$\overline{\text{STROBE}}$	IN	• Synchronous data read signal • Normally this is high. It is latched at the leading edge of the signal. • A pulse width of at least 0.5 μsec is required.	1
2	DATA 1	IN	• Each signal represents the data contained from bit 1 to bit 8. • Data 1: high Data 0: low • At least 0.5 μsec is required for each bit from the leading edge of the $\overline{\text{STROBE}}$ signal.	3
3	DATA 2			5
4	DATA 3			7
5	DATA 4			9
6	DATA 5			11
7	DATA 6			13
8	DATA 7			15
9	DATA 8			17
10	$\overline{\text{ACK}}$	OUT	• This pulse issued after storage of the data signals in the buffer, calls for transmission of the data signals. • This is normally high, and is about 9 μsec in width.	19
11	BUSY	OUT	• Input of data signals to the printer is inhibited when this is high.	21
12	PAPER OUT	OUT	• This signal is normally low, but goes high when there is no paper. However, it is maintained low then.	23
13	SELECTED	OUT	• When high, this signal indicates that the printer is in the online status.	25
14	NC (TTL LOW LEVEL)	IN	• Not used	27

Courtesy Star Micronics

PowerType Parallel Interface

(Continued)

Parallel interface connector pin No.	Signal name	I/O Classification	Description	CN1 pin No.
15	NC		• Not used	29
16	SIGNAL-GND		• GND level of the logic.	31
17	CHASSIS-GND		• Printer chassis GND level.	33
18	EXT. +5V	OUT	• Supply of +5V, max.50mA current from the printer to outside.	
19	GND		• Twisted pair return signal GND level.	2
20				4
21				6
22				8
23				10
24				12
25				14
26				16
27				18
28				20
29				22
30				24
31	$\overline{\text{INPUT PRIME}}$	IN	• Normally this is high, but if it goes low, the printer enters the initial state. (This is the same as the power on status). • For the receiving terminal, a pulse width of 50 μsec is necessary.	26
32	$\overline{\text{ERRROR}}$	OUT	• If the machine is in an abnormal condition, and printing is not possible, this signal is issued.	28
33	EXT. GND		• GND EXT. +5V	30
34	NC		• Not used.	32
35	NC		• Not used	34
36	NC		• Not used	36

Courtesy Star Micronics

PowerType Serial Interface

Serial interface connector pin No.	Signal name	I/O Classification	Description	CN6 pin No.
1	F-GND		• Printer chassis GND level.	1
2	TXD	OUT	• Transmission line for transmission of serial data from the printer to the host computer. The mark status will prevail as long as there is no transmission of characters. • If the data is "0", it will represent a space. If it is "1", it will represent a mark.	3
4	RTS	OUT	• Normally high level	7
5	CTS	IN	• If this signal is in the "space" level, the printer can receive data. • JP10 makes it possible to ignore this signal.	9
6	DSR	IN	• Normally ignored.	11
7	S-GND		• GND level of the logic.	13
8	DCD	IN	• Normally ignored.	15
9	TTY TXRDY		• Return signal corresponding to TXD 20mA current loop output signal.	17
10	TTY TXD	OUT	• TXD 20mA current loop output signal.	19

Courtesy Star Micronics

PowerType Serial Interface

(Continued)

Serial interface connector pin No.	Signal name	I/O Classification	Description	CN6 pin No.
11	REV-CH	OUT	• This is used when data is transmitted in the SERIAL BUSY mode. If in the "space" level, the signal indicates transmission request, if in the "mark" level, it indicates transmission disable.	21
12	NC		• Not used	23
13	S-GND		• GND level of the logic.	25
14	NC		• Not used.	2
15	NC		• Not used.	4
16	NC		• Not used	6
17	TTY TXRDY		• Return signal corresponding to TXD 20mA current loop output signal.	8
18	TTY RXRDY		• Return signal corresponding to 20mA current loop input signal.	10
19	TTY RXD	IN	• RXD 20mA current loop input signal.	12
20	DTR	OUT	• Normally high level	14
21	NC		• Not used.	16
22	NC		• Not used.	18
23	TTY RXRDY		• Return signal corresponding to RXD 20mA current loop input signal.	20
24	TTY TXD	OUT	• TXD 20mA current loop output signal.	20
25	TTY RXD	IN	• RXD 20mA current loop input signal.	24

Courtesy Star Micronics

ASCII Conversion Chart (0-9)

Binary	Decimal	Hexadecimal	ASCII Character	Control Activity
0110000	0	00	NUL	Null, tape feed
0110001	1	01	SOH	Start of heading
0110010	2	02	STX	Start of text
0110011	3	03	EXT	End of text
0110100	4	04	EQT	End of transmission
0110101	5	05	ENQ	Enquiry
0110110	6	06	ACK	Acknowledge
0110111	7	07	BEL	Rings a bell
0111000	8	08	BS	Backspace
0111001	9	09	HT	Horizontal tab

PERIPHERALS
UNIT VII

ASSIGNMENT SHEET #1 — DIAGRAM THE INTERFACE BETWEEN A MICROCOMPUTER AND A PARALLEL PRINTER

A. Tools and materials

1. User's manual for selected microcomputer
2. User's manual for selected parallel printer
3. Pencil, paper, and ruler

B. Procedure

1. Check the microcomputer user's manual for a diagram of the parallel printer output connector, then sketch the connector large enough that you can clearly label the output connectors pins
2. Check the printer user's manual for a diagram of the printer input connector, then sketch the connector large enough that you can clearly label the input connector pins
3. Use the ruler and pencil to connect the data lines 0 through 7 on a pin for pin basis between microcomputer output and the printer input connectors
4. Locate the data control pins on each connector and use the ruler and pencil to make connecting lines from the microcomputer output connector to the printer input connector on a pin for pin basis

   (NOTE: These are the handshake control pins for both the microcomputer and the printer, and since the printer literature may call them something different from what the microcomputer literature calls them, you may have to compare definitions to determine proper connections.)
5. Connect only the number of control pins that are available on the printer

   (NOTE: It is very possible that the printer will not use as many control pins as are available at the microcomputer.)
6. Connect the ground lines so that signal ground lines and power supply ground lines are properly connected

   (NOTE: Not all interfaces will have both types of ground lines, but beware of those that do and be sure to keep the two types of grounds separated.)
7. Have your instructor check your work

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ASSIGNMENT SHEET #2 — DIAGRAM THE INTERFACE BETWEEN A MICROCOMPUTER AND A SERIAL PRINTER

A. Tools and materials

1. User's manual for selected microcomputer
2. User's manual for selected serial printer
3. Pencil, paper, and ruler

B. Procedure

1. Check the microcomputer user's manual for a diagram of the serial printer output connector, then sketch the connector large enough that you can clearly label the output connector pins
2. Check the printer user's manual for a diagram of the printer input connector, then sketch the connector large enough that you can clearly label the input connector pins

   (NOTE: The printer input connector may or may not be a DB-25 because 36-pin Centronics connectors are also popular for serial interfaces.)
3. Use the ruler and pencil to connect the data lines first, and note that there is one data line for transmitting data and one line for receiving data, so draw the connections between the two
4. Use the ruler and pencil to next connect the handshake pins between the microcomputer and the serial printer
5. Connect only the number of control pins that are available at the printer

   (NOTE: Some of these interfaces are very simple and have only three connecting wires for transmit, receive, and ground.)
6. Use the ruler and pencil to connect the ground lines
7. Have your instructor check your work

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UNIT VII

JOB SHEET #1 — REPLACE RIBBON AND PRINT HEAD ON A DOT MATRIX PRINTER

A. Tools and equipment

1. Dot-matrix printer as selected by instructor

2. New print head as required

3. New ribbon as required

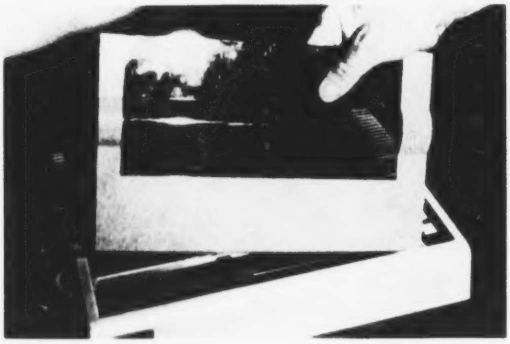
B. Procedure

1. Unplug the printer from the host system and from its power supply

   (NOTE: If the printer has been recently used for an hour or more, allow the print head to cool because they can get hot enough to burn your fingers.)

2. Remove the access cover to expose the ribbon and print head (Figure 1)

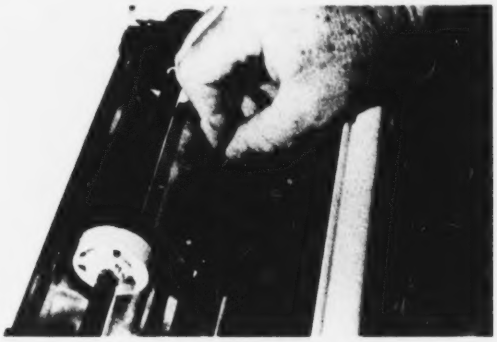
   FIGURE 1



JOB SHEET #1

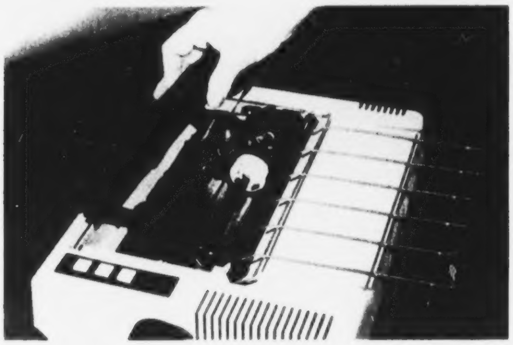
3. Lift the shield that runs the length of the ribbon along the carriage and fold it back out of the way (Figure 2)

FIGURE 2



4. Grasp the ribbon on each end and lift it up and out of the printer, but be careful not to let the ribbon catch the print head or it might tear a pin (Figure 3)

FIGURE 3



5. Lay the old ribbon aside

JOB SHEET #1

6. Take the new ribbon out of its box, remove any protective covering, and then take any slack out of the ribbon by turning the left end spindle counterclockwise by hand (Figure 4)

FIGURE 4

7. Place the new ribbon cartridge in place and snap it down into the printer

8. Make sure the ribbon at its contact point with the print head is forward of the print head ribbon shield and resting next to the platen

9. Turn the left hand spindle counterclockwise by hand once again to assure that all slack is taken out of the ribbon

10. Plug the printer back into its power source, turn the printer ON, and run a printer self test

    (NOTE: When there is any question about replacing a print head or a ribbon, always replace the ribbon first because that may be the least expensive way to solve a print problem, and if the new ribbon does not solve the problem, then replace the print head.)

    ☐ Have your instructor check your work, including the printer self test

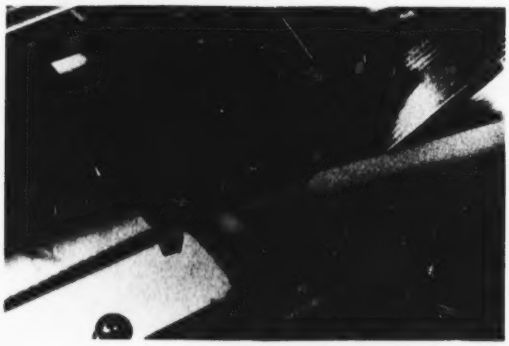
11. Turn the printer OFF and unplug it from the power source

12. Touch the print head lightly to make sure it's cool enough to handle

JOB SHEET #1

13. Look for the metal locking tab at the base of the print head and unsnap the print head locking device (Figure 5)

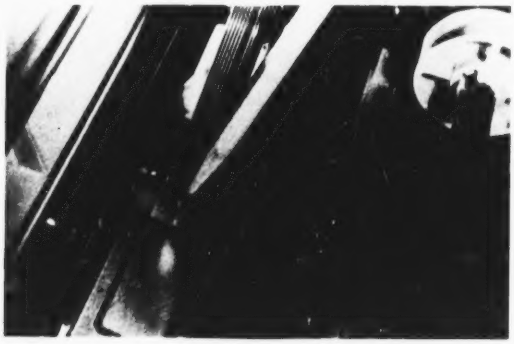
FIGURE 5



14. Pull the print head up so that the print head cable is readily accessible

15. Make sure you get hold of the reinforcing plastic tab on the print head cable, then disconnect it and lay it and the print head aside (Figure 6)

FIGURE 6



JOB SHEET #1

16. Install the new print head by replacing the print head cable first or snapping the print head itself back into place first and then attaching the cable (Figure 7)

    (**CAUTION:** When a print head has to be replaced because of broken wires in the matrix, it is a good sign that other adjustments need to be made before running a printer self test, so check with your instructor before continuing.)

    FIGURE 7

17. Plug the printer back into its power source, turn the printer ON, and run another printer self test

    ☐ Have your instructor check your work, including the printer self test

18. Turn the printer OFF, unplug it from its power source, and replace the access cover

19. Clean up area and return tools and equipment to proper storage

PERIPHERALS
UNIT VII

JOB SHEET #2 — HOOK UP DISK DRIVES TO AN APPLE MICROCOMPUTER

A. Tools and equipment

1. Apple microcomputer as selected by instructor
2. Owner's manual
3. Disk drive or drives
4. Proper disk driver card
5. Disk operating system and disk diagnostics
6. Basic hand tools

B. Procedure

1. Make sure microcomputer is unplugged from its power source
2. Remove the cover from the microcomputer
3. Check the disk driver card that comes with the system to make sure it is the proper card

   (NOTE: The disk driver card is supplied with the first disk drive, and if it is not, or if the driver card appears to be an improper one, check with your instructor.)

4. Connect the cable from the disk drive to the driver card according to the following:

   a. If you are connecting only one drive, connect the cable to drive 1 on the driver card

   b. If you're connecting two drives, connect the cable for drive 2 to the lower connector on the driver card, the one that points down

5. Make certain the connectors and pins are in proper alignment and then seat the disk drive connectors firmly in their places on the driver card
6. Place the driver card into slot 6 on the system bus and seat it with a rocking end-to-end motion, not a side-to-side motion

   (NOTE: The card cannot go in backwards, so if you're having difficulty, stop and check your procedure, and should the installation information indicate you should be using a slot other than slot 6, check with your instructor because almost all Apple software treats the disk drives as being in slot 6.)

JOB SHEET #2

7. Route the disk drive ribbon cable so that it lies flat over the top of the computer case at the back, and if there is a strain-relief clamp on the cable, make sure it stays inside the case

8. Have your instructor check your work

9. Reposition the case so that it will secure the drive cable in place and then secure the case

10. Open the door(s) of the disk drive(s) and remove the head protector cardboard(s) from the disc drive(s) and be sure to save for future use

11. Turn the power ON and insert the Apple DOS into drive 1

12. Check the monitor for screen information that indicates drive 1 is working properly

    a. If drive 1 is okay, check drive 2 with the same procedure

    b. If drive 1 is not okay, turn power OFF and recheck everything, especially that the driver card is in slot 6

13. Turn power ON and make a second check as necessary

    a. If second check on drive 1 is okay, go on and check drive 2, if necessary

    b. If second check on drive 1 is not okay, run the diagnostic disk

    c. If diagnostic disk will not run, substitute a known good driver card

    d. If diagnostic disk will still not run, substitute a known good disk drive(s)

    e. If there are still problems, the fault is probably somewhere else in the system, so check with your instructor

    f. If substitution of the driver card or the disk drive solves the problem, run all checks again

    ☐ Have your instructor check your work and discuss any problems with your instructor

14. Clean up area and return tools and equipment to proper storage or prepare for next job sheet as directed by your instructor

PERIPHERALS
UNIT VII

NAME ________________________

TEST

1. Match the terms on the right with their correct definitions.

______a. American Standard Code for Information Interchange, the seven-bit binary code used to represent letters and numbers

______b. Short for Baudot, a code for rating the speed at which information is sent and received

______c. The way the components in a microcomputer system are arranged to interact with each other and with the system

______d. Dual in-line package, the standard hardware form used for housing integrated circuits

______e. Small switches built into a DIP so that the function of the IC can be modified without requiring a hardware change

______f. Cables and connectors or any devices which make it possible for two devices to exchange signals so controlled that the devices can "talk" to each other

1. BAUD
2. DIP switches
3. Configuration
4. ASCII
5. Interface
6. DIP

2. Complete the following statements concerning modes for printer interfacing by inserting the word(s) that best completes each statement.

a. Printer interfacing is done in either:

1) The ______________ mode

2) The ______________ mode

b. When information is sent to a printer in ______________ mode, an entire word is sent in one timing cycle

c. When information is sent to a printer in ______________ mode, it goes one bit at a time as an ASCII word in one timing cycle

TEST

3. Select true statements concerning ASCII codes and what they mean by placing an "X" in the appropriate blank.

(NOTE: For a statement to be true, all parts of the statement must be true.)

_____a. ASCII codes are seven-bit binary numbers for:

1) Lowercase letters of the alphabet

2) Uppercase letters of the alphabet

3) Punctuation and graphics marks

4) Math and scientific symbols

5) Control functions for communications

_____b. ASCII codes were designed originally for television equipment, and although many ASCII codes do not apply to microcomputer use, they are used in both printer and terminal control

4. Complete the following statements concerning dot matrix printer operations by inserting the word(s) that best completes each statement.

a. Because they produce both alphanumeric ____________ and ____________ too, dot matric printers are the ones most frequently used and the ones most often repaired

b. A dot matrix printer works with a print head that is a package of ____________ with wires attached to them

c. When a ____________ or group of ____________ is activated, the wires push forward from the head, make contact with an inked ribbon, and force the ribbon to contact the paper and leave an image formed from closely-spaced dots

d. Because the wires are placed so close together, the ____________ between the dots is not highly visible, and some dot matrix printers go back over the area with the head slightly offset to fill in space between dots and create a better looking character

e. As dot matrix printers have improved, the heads use a single vertical row of wires and software is used to control spacing in a ____________ axis so that additional wires can be used to improve appearance

f. Since dot matrix printers can produce both characters and graphics, they will continue to be popular, and knowing how they work will provide a good background for ____________

TEST

5. Select true statements concerning ink jet printer operations by placing an "X" in the appropriate blanks.

_____a. Ink jet printers work on the same principle as a dot matrix printer except that the wires in the head are actually miniature tubes that transport ink

_____b. Ink jet printers eliminate the need for a ribbon, and have no maintenance problems at all

_____c. Because of their almost silent operating characteristics, ink jet printers promise to become popular and will require a repair technician to know how to maintain and repair them

6. Select true statements concerning laser printer operations by placing an "X" in the appropriate blanks.

_____a. Laser printers deposit a charge on the paper surface and the image is transferred via the charge, a procedure much like the one used in standard office copying machines

_____b. Quality from a laser printer is so good that some off-set printing will not compare with it, but laser printers are very expensive, their use is limited but their maintenance is surprisingly simple

7. Complete the following statements concerning letter quality printer operations by inserting the word(s) that best completes each statement.

a. Letter quality printers work a good deal like _____________, and many typewriter manufacturers are simply interfacing their electronic typewriters to computers and selling them as printers

b. Letter quality printers use some kind of movable characters on devices such as a daisy wheel, print cylinder, or print ball, and as the name suggests, they produce letter quality characters, but will not produce _____________

c. The typewriter-like construction of letter quality printers requires more _____________ maintenance and _____________ repair than dot matrix printers

8. Differentiate between common electrical levels used for sending serial information by placing an "X" beside the definition of RS-232C.

_____a. A standard which uses voltage levels to represent bits in ranges of plus or minus 5 volts to plus or minus 15 volts

_____b. A defacto standard which uses current levels to represent bits so that a 0 or low bit is 0 to 3 mA and a high bit or 1 is from 15 to 20 mA

TEST

9. Complete the following statements concerning BAUD rates and printer switch setup by inserting the word(s) that best completes each statement.

   a. Most printers have ____________ BAUD rate capabilities and the positioning of BAUD rate switches will be pictured in the microcomputer user's manual

   b. The objective is to match the ____________ ____________ of the printer with that of the computer because they should be the same

   c. When a customer has a printer, especially a new printer that does not work, it's always wise to check BAVD rates and ____________ ____________ because the problem might be quickly solved by resetting a switch

10. Complete the following statements concerning BAUD rates by inserting the word(s) that best completes each statement.

    a. BAUD rate is the rate at which ____________ information is sent or the rate at which "bits" of information are sent

    b. An entire ____________ character is sent in a time period that prescribes the BAUD rate of the machine

    c. A rule of thumb is that the time frame gets ____________ as the BAUD rate number gets smaller

    d. BAUD rates on modern video equipment can run as high as 4,800 BAUD, but when extremely high BAUD rates are used with printers, information must be ____________ ____________ ____________ in the printer so that the printer can work at its highest rate possible yet not exceed the limitations of its mechanical capabilities

11. Select true statements concerning printer handshaking protocol by placing an "X" in the appropriate blanks.

    (NOTE: For a statement to be true, all parts of the statement must be true.)

    _____a. When a printer with a serial interface has no printer (buffer) memory, then the rate of exchange between the microcomputer and the printer must be controlled through a handshaking protocol

    _____b. Handshaking protocol is typically used with a serial printer interface and:

    1) Enables the computer to recognize when the printer is free to accept information

    2) Enables the computer to change one of its handshake lines to indicate that information has been sent to the printer

    3) At the end of a transmitted character, it will enable the printer to change one of its handshake lines to indicate acceptance which in turn will tell the computer to send the next character

    _____c. A minimum of four handshake lines is necessary, but some systems have more

TEST

12. Solve the following problem concerning cable configurations for information transmission.

Problem: A DTE cable is connected to a piece of DCE equipment, and a customer complains of malfunctioning equipment.

Solution: ____

____

13. Select true statements concerning modems and how they work by placing an "X" in the appropriate blanks.

_____a. Modems are always attached to a parallel connection on a computer because a modem has no way of handling information in a serial mode

_____b. Modem BAUD rates must agree with the computer, and switch settings are very different from those used with printers

_____c. Switch settings cannot be used on modems to satisfy handshaking requirements; this must be done with cables

_____d. Modems used with microcomputers are in no way controlled by software

_____e. Modems pose big problems for repair technicians because they're small and difficult to take apart

14. Complete the following statements concerning floppy disk drives by inserting the word(s) that best completes each statement.

a. Mechanical varieties:

1) ____________ height

2) ____________ height

b. Typical disk drive sizes

1) ____________ — Most common

2) ____________ — Used with some business systems and can still be purchased as external drive for many systems

3) ____________ — These come in hard plastic cases that make them look like cassettes, but they're floppies, can store much more information than a standard ____________ floppy, and are appearing in more and more systems

TEST

15. Select true statements concerning media for floppy disk drives by placing an "X" in the appropriate blanks.

_____a. Media for floppy disk drives may be:

1) Single or double sided

2) Single or double density

_____b. Media requirements vary from system to system, but it is very important that the media combination recommended for the floppy drive be used with that drive

_____c. In general, double-density floppies have a thicker oxide coating, must meet high quality control standards, and can simply store more information than single-density floppies

_____d. A single-sided floppy may work in a double-sided drive, but this is strictly a hit-or-miss situation because although the second side of a single-sided floppy has an oxide coating, the oxide has not been finished or tested like the first side

_____e. When floppy disk drives are operating properly but problems with data loss still occur, the problem is usually in the microprocessor

16. Complete the following statements concerning hard disk drives by inserting the word(s) that best completes each statement.

a. When working with a hard disk drive, there are some important items to remember:

1) Hard disk drives cost about ____________ to ____________ times as much as floppy disk drives

2) Hard disk drives are constructed ____________ ____________ from floppy disk drives

3) Hard disk drives require a separate and different ____________ ____________ in the microcomputer

b. A hard disk drive is a sealed system:

1) The media is a hard ____________ ____________ coated with oxide

2) The read/write head rides on a cushion of ____________ or ____________ and does not make contact with the oxide surface of the media

3) Any hard disk system with removable media means that when the media is removed, the ____________/____________ ____________ is also removed with it

TEST

c. Since it's economically sensible for a microcomputer system to have only one hard disk, a backup procedure is required

1) Backup can be made on floppy disks, but it would take about ____________ floppies to handle the ____________ megabytes a hard disk might contain, so this kind of backup is time consuming

2) More modern backup systems use high-speed tape cartridges that can transfer in less than ____________ ____________ what it might take half a day to transfer onto floppies

d. For customers who require hard drives added to a microcomputer system, it can be done if the system has card slots or special provisions for ____________ drive applications

17. Complete the following statements concerning classifications of computer terminals by inserting the word(s) that best completes each statement.

a. Intelligent (smart) — A terminal with its own ____________ on board so a user can program as well as send and receive information

b. Nonintelligent (dumb) — A terminal capable of sending and receiving, but one with no ____________ capability

c. Printing — A terminal that is essentially a printer with a keyboard, or receives information as hard copy on the printer, but it has no ____________

d. Video — A terminal that cannot make ____________ ____________ of information received or sent, but will screen information on a video display and send it or receive information from a remote source and display it on the screen

e. Terminals are often used in minicomputer systems, but are also being used in large ____________ systems

f. Terminals for a microcomputer system require proper software and normal ____________ communications

18. Select true statements concerning microcomputer cassette recorders by placing an "X" in the appropriate blanks.

_____a. Cassette recorders used with microcomputers are similar to those used for everyday audio recording and playback except that they have been modified so that they can be started, stopped, and sometimes backed up by computer commands

_____b. Cassette recorder used with microcomputers require normal tape

_____c. Normally, these cassette recorders are serviced as standard cassette recorders are, mostly by cleaning and aligning recording and playback heads

TEST

19. Complete the following statements concerning memory expansion with RAM cards by inserting the word(s) that best completes each statement.

    a. RAM disk or RAM drive are two other names given to the large ____________ ____________ sometimes added to a microcomputer system to increase memory and programming speed

    b. These devices are also called ____________ ____________ on-board RAM's because they need battery backup power to keep from losing the contents of RAM when power is turned off

    c. Once data manipulation has been completed in the RAM drive, the data is normally sent from the RAM back to a ____________ for permanent storage

20. Complete the following statements concerning special cards and their uses by inserting the word(s) that best completes each statement.

    a. Multi-purpose cards contain a number of features on one printed circuit board

        1) May contain either a ____________ or ____________ port or both

        2) May have real time and date functions, frequently with ____________ backup

        3) Some may also contain memory in the form of ROM or with program capabilities in a ____________ ____________

    b. Because of their special features, ____________ ____________ cards are the most popular with users

    c. Single purpose cards are inserted in a microcomputer to perform a given function

        1) On command, an ____________ chip will accept information stored in memory, store it, and save it even after power is turned off

        2) The ____________ chip can be reprogrammed after erasing it with an ultraviolet light box

        3) ____________ cards are frequently required to drive a mouse, a graphics tablet, or a light pen

        4) ____________ cards are also used as ____________ and ____________ disk controllers

        5) ____________ cards also serve as industrial controllers for operating equipment ____________ to the computer, items such as robotic arms

        6) ____________ cards provide communications and protocols for getting a microcomputer "on line" with a network

TEST

21. Select true statements concerning how networks operate by placing an "X" in the appropriate blanks.

_____a. Computer networks pool hardware and software resources in such a way that a microcomputer user can not only exchange information, but actually use hardware and software features of other computers in the system

_____b. LAN's have become popular among industries because a number of small microcomputers using a LAN could communicate with one large, hard storage disk or use on expensive laser printer

22. Complete statements concerning hardware and software requirements for networking by inserting the word(s) that best complete each statement.

a. Special hardware is required to attach the computer to the network cable

1) The hardware, simply speaking, takes the normal computer output and changes it into a _____________ _____________ communications form

2) Hardware also establishes the electrical _____________ used by the system to determine which computer is in control at a given time

b. Special software is required, and must be compatible with the LAN hardware because:

1) Software protocols control procedures for getting "_____________" and "_____________" the network

2) Software protocols also control procedure for _____________ _____________ of certain features of the system

c. Some networks do not require special hardware or software because they use _____________ to gain access to telephone equipment which links network participants together

23. Match graphics devices with their characteristics.

_____a. Essentially an electromechanical or electro-optical device so connected to a computer that a user can move it on a flat surface to generate a duplicate cursor movement on the video display

_____b. A hand-held device that is placed on the screen of the video display so that when the light of the display crosses the pen, it causes the X Y coordinates of the screen location to be placed into memory

_____c. Use X and Y coordinates in the hardware to represent some feature stored in ROM, and when the coordinates are activated by a stylus, the information is transferred into RAM

1. Light pen
2. Graphic pads and touch tablets
3. The mouse

TEST

24. Select true statements concerning characteristics of CRT-based video displays by placing an "X" in the appropriate blanks.

______a. Displays are classified according to resolution only

______b. Resolution is a way in which the number of points on a video display are referenced in both the horizontal and vertical directions, and the higher the number of points, the higher the resolution

______c. Monochrome or single color displays may be black and white, green, amber, or almost any color, and most monochrome video displays are high resolution displays

______d. Because they are high resolution, monochrome displays require a monochrome driver card capable of producing the resolution desired on the screen

______e. A monochrome driver card may or may not produce an output that gives a resolution a high as the video display is capable of

______f. An RGB display is the equivalent of a TV monitor, but the resolution is much lower

______g. An RGB display will run off a monochrome driver card

______h. To drive a TV set for use as a video display requires "composite" driver card or an RGB drive card that will also handle a composite signal

______i. Some graphics cards are capable of driving all three types of video signals, but these cards are very expensive

______j. Since most TV sets accept RF input only, an RF adapter is required for the computer to work with a normal TV set

25. Complete statements concerning other types of video displays by inserting the word(s) that best complete each statement.

a. Some special purpose video displays are not ____________ type displays

b. When a computer is required to display only alphanumeric characters, then character-oriented displays such as ____________ and ____________ can be used

c. Seven-segment ____________ and ____________ used in character displays can be driven off the parallel peripheral chip and controlled by machine language software

d. Another LCD use is in the new, large ____________ ____________ display in some of the new portable computers, where the flat profile of the LCD can be neatly folded into the computer to create a modern-looking, low-profile piece of equipment

e. ____________ screen LCD's require drive circuitry similar to CRT operation

TEST

26. Select true statements concerning switch boxes and their uses by placing an "X" in the appropriate blanks.

_____a. Switch boxes are handy devices that are frequently used to connect two microcomputers to one printer

_____b. Switch boxes are also used to switch parallel and serial cables from the output of a computer

_____c. The switching arrangement is controlled by the arrangement of cable connections in the switch box

_____d. Switch boxes are relatively inexpensive but when one malfunctions, it is usually repaired

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

27. Diagram the interface between a microcomputer and a parallel printer. (Assignment Sheet #1)

28. Diagram the interface between a microcomputer and a serial printer. (Assignment Sheet #2)

29. Demonstrate the ability to:

    a. Replace the ribbon and print head on a dot-matrix printer. (Job Sheet #1)

    b. Hook up disk drives to an Apple microcomputer. (Job Sheet #2)

PERIPHERALS
UNIT VII

ANSWERS TO TEST

1. a. 4
   b. 1
   c. 3
   d. 6
   e. 2
   f. 5

2. a. 1) Parallel or serial
      2) Serial or parallel
   b. Parallel
   c. Serial

3. a

4. a. Characters, graphics
   b. Solenoids
   c. Solenoids, solenoid
   d. Space
   e. Horizontal
   f. Troubleshooting

5. a,c

6. a

7. a. Typewriters
   b. Graphics
   c. Mechanical, mechanical

8. a

9. a. Multiple
   b. BAUD rate
   c. Switch settings

10. a. Serial
    b. ASCII
    c. Longer
    d. Stored in memory

11. a,b

12. Replace the DTE cable with a DCE cable

ANSWERS TO TEST

13. None of the statements are true

14. a.
    1) Single
    2) Half

    b.
    1) 5 1/4"
    2) 8"
    3) 3 1/2"

15. a,b,c,d

16. a.
    1) Three, five
    2) Entirely different
    3) Controller card

    b.
    1) Metal platter
    2) Air, gas
    3) Read/write head

    c.
    1) 40, 10
    2) 30 seconds

    d. External

17. a. Computer
    b. Computing
    c. Video
    d. Hard copies
    e. Microcomputer
    f. Serial

18. a,c

19. a. RAM card
    b. Battery-backed
    c. Floppy

20. a.
    1) Serial, parallel
    2) Battery
    3) RAM disk

    b. Multi-purpose

    c.
    1) EPROM
    2) EPROM
    3) Special
    4) Special, floppy, hard
    5) Special, external
    6) Networking

21. a,b

22. a.
    1) High-speed
    2) Protocols

    b.
    1) On, off
    2) Requesting use

    c. Modems

ANSWERS TO TEST

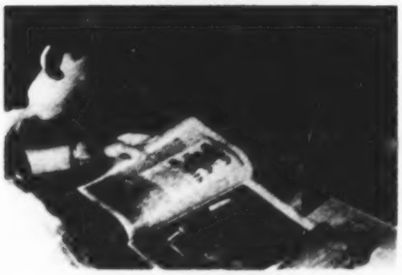
23. a. 3
    b. 1
    c. 2

24. b,c,d,e,h,i,j

25. a. CRT
    b. LED's, LCD's
    c. LED's, LCD's
    d. Flat-screen
    e. Large

26. a,b,c

27. Evaluated to the satisfaction of the instructor
28. Evaluated to the satisfaction of the instructor
29. Competencies evaluated according to written procedures in the job sheets



PUBLICATIONS AND RESOURCES
UNIT VIII

UNIT OBJECTIVE

After completion of this unit, the student should be able to list publications necessary for troubleshooting and repair of microcomputers and peripherals, and discuss the value of trade journals, user groups, and support groups to microcomputer users and repair technicians. These competencies will be evidenced by correctly completing the procedures outlined in the assignment sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to publications and resources with their correct definitions.
2. Match equipment manuals with their characteristics.
3. Complete statements concerning schematics and troubleshooting guides.
4. Select true statements concerning warranties.
5. Complete statements concerning block diagrams and wiring diagrams.
6. Complete statements concerning trade journals.
7. Select true statements concerning user groups.
8. Complete statements concerning support groups.
9. Select resources to help solve microcomputer service problems. (Assignment Sheet #1)
10. Conduct a survey of a local user's group. (Assignment Sheet #2)

PUBLICATIONS AND RESOURCES
UNIT VIII

SUGGESTED ACTIVITIES

A. Provide student with objective sheet.

B. Provide student with information, assignment, and job sheets.

C. Make transparencies.

D. Discuss unit and specific objectives.

E. Discuss information and assignment sheets.

F. Have user manuals available for different brands of microcomputers so students can compare them, and pass available technical and maintenance manuals around so students can see what they contain and get a better idea of how they can be used in servicing and troubleshooting.

G. Invite the president or a member of a local or area user group to talk to the class about how the group got started, how many members are in the group, what walks of life the members are from, and some of the things that take place at a club meeting.

H. Arrange for students to visit user group meetings in the area and then report on the type of microcomputer the group members are mutually concerned with, what's available in member-produced software, and what members do when their computers or peripherals malfunction.

I. Have each student prepare a short research article from any one of the trade journals available in your area. The article should reflect the contents of at least three issues of the journal, and pay special attention to areas of maintenance, troubleshooting, repair, and reader letters that concern computer problems.

J. Give test.

CONTENTS OF THIS UNIT

A. Objective sheet

B. Information sheet

C. Transparency masters

    1. TM 1 — Printer Warranty
    2. TM 2 — Block Diagram
    3. TM 3 — Wiring Diagram
    4. TM 4 — User Group Brochure
    5. TM 5 — Support Group Information

CONTENTS OF THIS UNIT

D. Assignment sheets

  1. Assignment Sheet #1 — Select Resources to Help Solve Microcomputer Service Problems

  2. Assignment Sheet #2 — Conduct a Survey of a Local User's Group

E. Answers to assignment sheets

F. Test

G. Answers to test

REFERENCES USED IN DEVELOPING THIS UNIT

A. *Z-100 User's Manual.* St. Joseph, MI 49085: Zenith Data Systems, 1983.

B. Johnston, Chris. *The Microcomputer Builder's Bible.* Blue Ridge Summit, PA 17214: Tab Books Inc., 1982.

C. *Computerworld Buyer's Guide* (Vol. 18, No. 39A). Framingham, MA 01701: CW Communications, Inc., September 26, 1984.

D. *Introduction to Microcomputer Applications.* Stillwater, OK 74074: The Mid-America Vocational Curriculum Consortium (MAVCC), 1984.

PUBLICATIONS AND RESOURCES
UNIT VIII

INFORMATION SHEET

I. **Terms and definitions**

A. Field service — Any service performed at other than a repair center designated by the OEM

B. Hot line — A telephone number known only to selected persons who may use the number for emergency or information services

C. OEM — Original equipment manufacturer

D. Private domain — Materials that are copyrighted and whose use may entail the payment of a fee which is usually included in the purchase price

E. Public domain — Materials that are not copyrighted and are available free for public use

F. Trade journal — A magazine or newspaper dedicated to a general industry or occupation or a specific element within the industry or occupation

Example: *Personal Computing* is dedicated to computers in general, and *PC* is dedicated to the IBM Personal Computer

G. User groups — Individuals who join together at regular club meetings to exchange working experiences and otherwise share their mutual interest in a given brand of microcomputer

H. Warranty — A written statement that outlines the conditions of time and use under which a manufacturer will pay for repair or replacement of a piece of equipment that fails

(NOTE: Most warranties are limited to a time period and to conditions of normal, as opposed to abusive, use.)

II. **Equipment manuals and their characteristics**

A. User manuals — Should be supplied with computers, computer peripherals, and testing and laboratory equipment, and if they are not supplied with the equipment, they should be ordered from the manufacturer

B. Software manuals — Are normally only available to the software buyer, so when troubleshooting indicates a software problem, the customer should be notified it is not a service problem

C. Technical manuals — Sometimes come with original equipment, but frequently have to be purchased from the manufacturer, and often are released to companies who have representatives attend computer repair schools run by manufacturers

(NOTE: A technical manual is necessary to properly service almost any type of computer equipment.)

INFORMATION SHEET

D. Maintenance manuals — These are extended tech manuals that contain specific information about testing, hooking up instrumentation equipment, disassembly and reassembly of components, and repair hints and procedures

(NOTE: Maintenance manuals usually serve an entire product line and are updated as required by the manufacturer.)

III. **Schematics and troubleshooting guides**

A. Schematics and troubleshooting guides are published by many manufacturers of disk drives, printers, video display units, and other peripherals, and these materials are necessary to facilitate better and more efficient troubleshooting

B. Another excellent source of schematics and troubleshooting guidelines is Computerfacts™

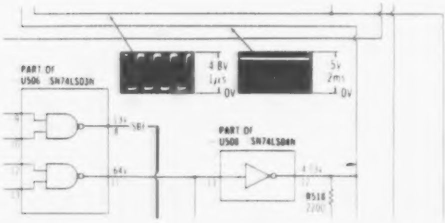
(NOTE: Computerfacts is a trade mark of the publisher, Howard W. Sams and Co., Inc., of Indianapolis, Indiana.)

C. Computerfacts are available for most of the popular brands of microcomputers, disk drives, printers, and video display units

D. Major components in a typical Computerfacts include:

1. A list of preliminary service checks
2. Schematics including standard notations for waveforms, voltages, and stage identification (Figure 1)

FIGURE 1



INFORMATION SHEET

3. Step by step troubleshooting guides

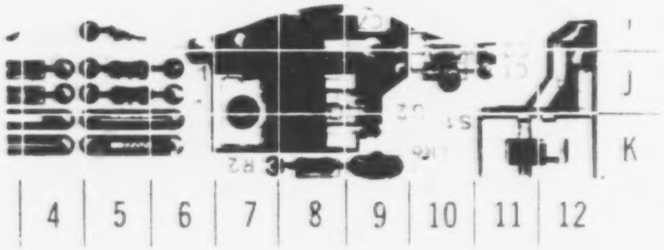
4. A component by component parts list (Figure 2)

FIGURE 2

ITEM No	TYPE No	MFGR PART No	REPLACEMENT DATA						
			ECG PART No	GENERAL ELECTRIC PART No	MOTOROLA PART No	NTE PART No	RCA PART No	WORKMAN PART No	ZENITH PART No
D102	1SS53	1149-2576	ECG519	GE-514	1N4935	NTE519	SK9091/177	WEP925/519	103-131
D103	1N60FM	1149-2527	ECG109	1N60		NTE109	SK3088	WEP134/109	103-Z9001
D201	1N4004GP	1201-4205	ECG116	GE-504A	1N4004	NTE116	SK3312	WEP157	212-76-02
D501 thru D503	1SS53	1149-2576	ECG519	GE-514	1N4935	NTE519	SK9091/177	WEP925/519	103-131

5. Excellent photographs with map-type grid references to help locate components quickly (Figure 3)

FIGURE 3



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INFORMATION SHEET

6. A logic chart to assist in finding faulty circuitry with a logic probe (Figure 4)

FIGURE 4

PIN NO.	IC U100	PIN NO.	IC U100	PIN NO.	IC U102	IC U103	IC U104	IC U105	IC U106	IC U107	IC U108	IC U109
1	P	21	P	1	L	L	L	L	L	L	L	L
2	P	22	P	2	P	P	P	P	P	P	P	P
3	P	23	P	3	H	H	H	H	H	H	H	H

IV. **Warranties** (Transparency 1)

A. When reading a warranty, it is important to determine the nature of any field service that would invalidate all or part of the warranty

B. Most warranties specify what areas of the equipment are the province of the manufacturer only, and these restricted areas should be left alone

(NOTE: One major computer company has a regulation against soldering on the main board or any part of the equipment, and the regulation applies even to computers out of warranty — in other words, if the equipment has been soldered on, it voids the warranty, and if the equipment is out of warranty, the company will not service it.)

C. Examine warranties carefully to determine under what conditions seals can be broken

(NOTE: The sealant or paint used to seal some screws can sometimes be broken to complete certain repair procedures, but always check the warranty before breaking the seal on a screw that is sealed.)

D. Examine time limits on warranties carefully because they vary with manufacturer, and careless reading of a warranty can lead to unpleasant customer relations

V. **Block diagrams and wiring diagrams** (Transparencies 2 and 3)

A. Both block diagrams and wiring diagrams should be found in the user manuals and/or technical manuals

B. Block diagrams give general flow-type information and wiring diagrams give detailed patterns of wiring between components in a system

C. Appropriate diagrams should always be consulted prior to and during troubleshooting routines

INFORMATION SHEET

VI. **Trade journals**

A. Almost every microcomputer on the market has one or more trade journals which supports the microcomputer or a particular product line

B. The more popular microcomputers have not only one support journal but four, five, or six trade journals that support them

C. In some cases, a trade journal will support a microprocessor type instead of a specific microcomputer

Example: *MICRO* is a trade journal that mostly supports the 6502 microprocessor, and *COMPUTE* is a trade journal that supports computers such as Commodore, Atari, Apple, and others that use the 6502 microprocessor

D. Trade journals are sometimes good sources for troubleshooting tips, and especially good sources for input from computer users who have solved peculiar problems or have peculiar problems that need solving

VII. **User groups** (Transparency 4)

A. User groups exist at the national, state, and local levels

B. National and state user groups are good places to obtain libraries of software and information about new products, hardware, software, and special applications

C. The most useful of the user groups is at the local level where people with the same kind of equipment use their combined knowledge to solve problems

D. Some user groups have hot lines reserved for members only

E. Members of user groups are good people to know because they can best identify problems common to one microcomputer and that computer's behavioral characteristics with certain peripherals

VIII. **Support groups** (Transparency 5)

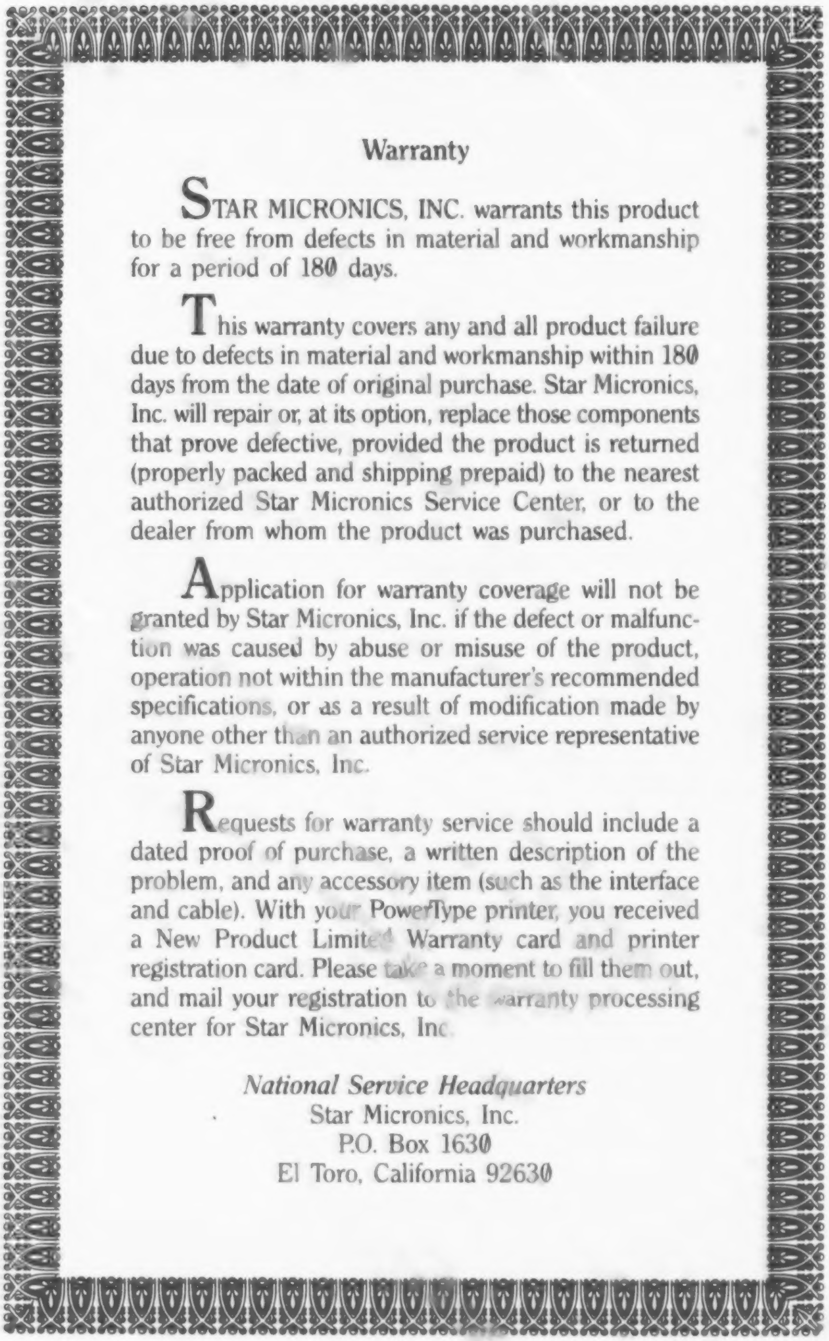
A. Support groups are technical groups linked to the manufacturers of computers, and both hardware and software

B. Some support groups have a hot line service where registered owners of their specific product line can call for help

(NOTE: Most hot lines operate during normal Monday through Friday business hours, but some operate 24 hours a day, seven days a week.)

C. Technical support groups can be very useful for specific equipment problems, and hot line numbers that can be used should be listed where they will be available as needed

Printer Warranty



Warranty

STAR MICRONICS, INC. warrants this product to be free from defects in material and workmanship for a period of 180 days.

This warranty covers any and all product failure due to defects in material and workmanship within 180 days from the date of original purchase. Star Micronics, Inc. will repair or, at its option, replace those components that prove defective, provided the product is returned (properly packed and shipping prepaid) to the nearest authorized Star Micronics Service Center, or to the dealer from whom the product was purchased.

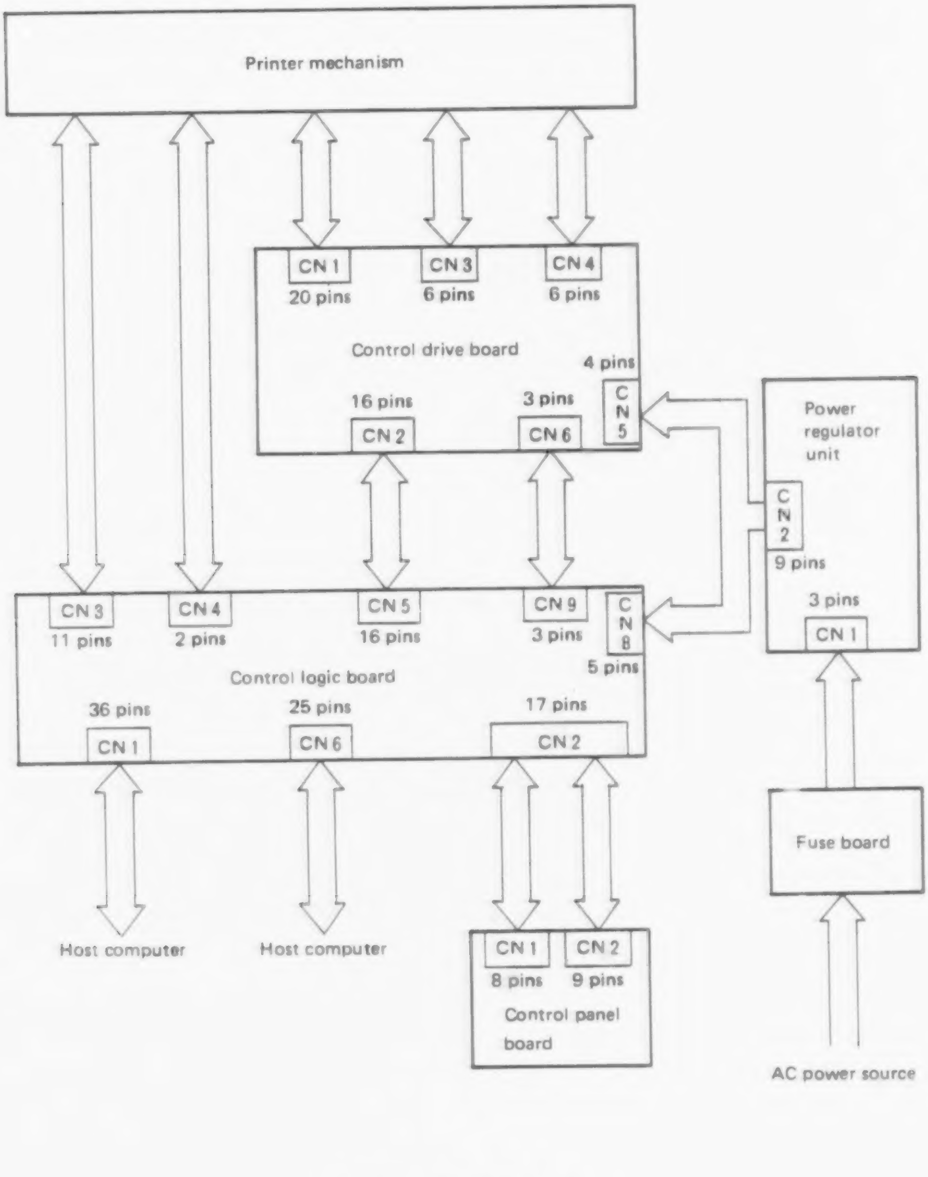
Application for warranty coverage will not be granted by Star Micronics, Inc. if the defect or malfunction was caused by abuse or misuse of the product, operation not within the manufacturer's recommended specifications, or as a result of modification made by anyone other than an authorized service representative of Star Micronics, Inc.

Requests for warranty service should include a dated proof of purchase, a written description of the problem, and any accessory item (such as the interface and cable). With your PowerType printer, you received a New Product Limited Warranty card and printer registration card. Please take a moment to fill them out, and mail your registration to the warranty processing center for Star Micronics, Inc.

National Service Headquarters
Star Micronics, Inc.
P.O. Box 1630
El Toro, California 92630

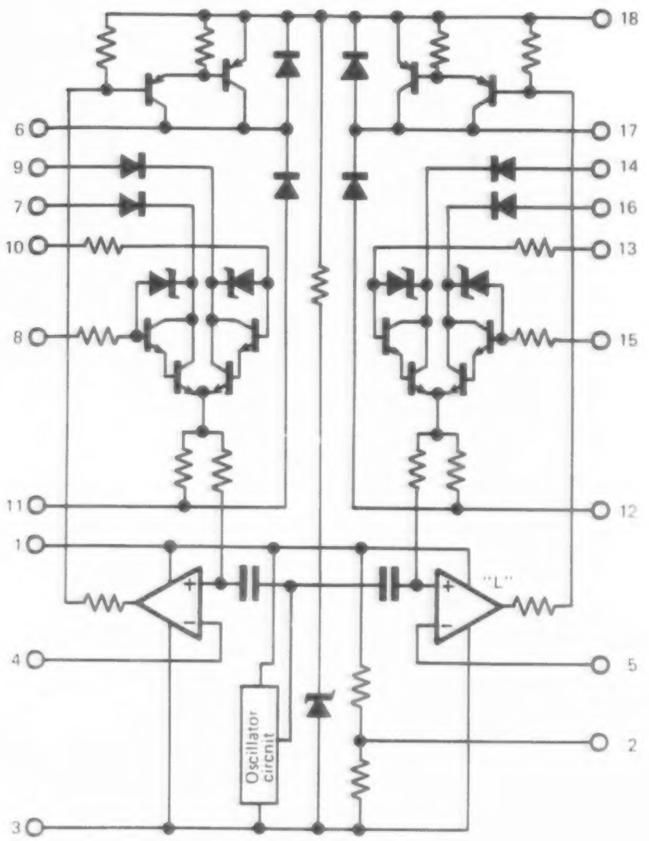
Courtesy Star Micronics

Block Diagram



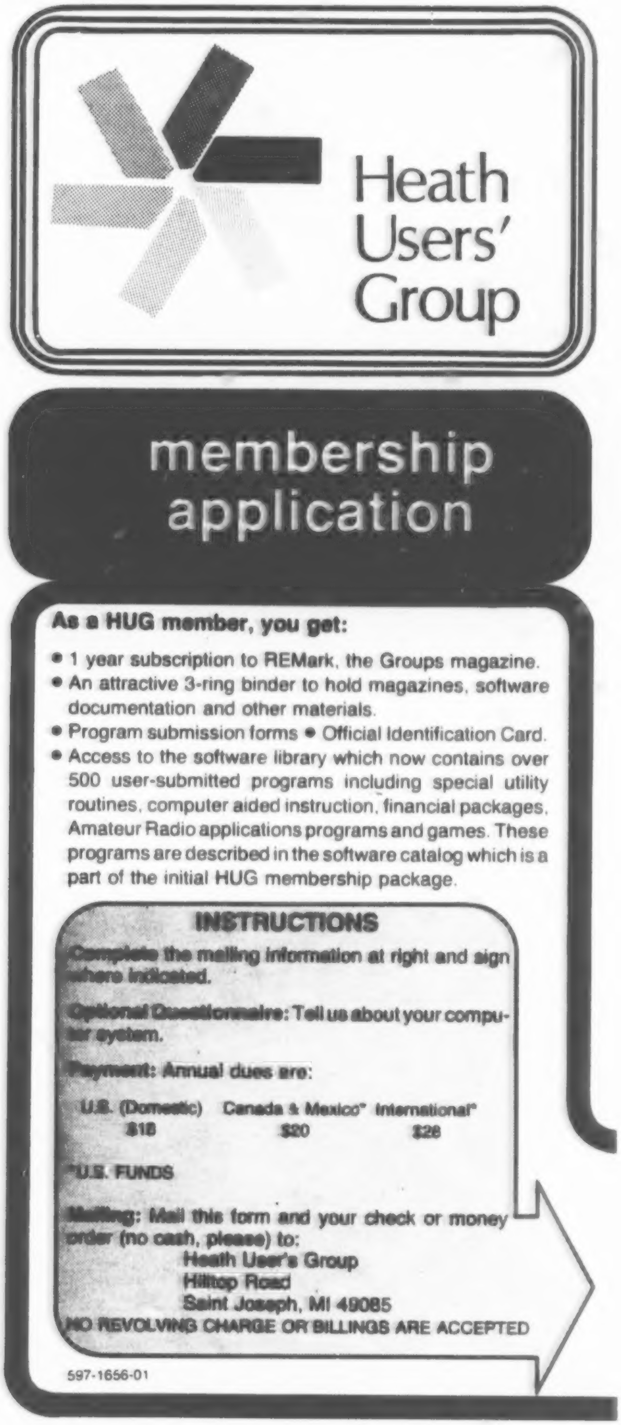
Courtesy Star Micronics

Wiring Diagram



Courtesy Star Micronics

User Group Brochure



Heath Users' Group

membership application

As a HUG member, you get:

- 1 year subscription to REMark, the Groups magazine.
- An attractive 3-ring binder to hold magazines, software documentation and other materials.
- Program submission forms • Official Identification Card.
- Access to the software library which now contains over 500 user-submitted programs including special utility routines, computer aided instruction, financial packages, Amateur Radio applications programs and games. These programs are described in the software catalog which is a part of the initial HUG membership package.

INSTRUCTIONS

Complete the mailing information at right and sign where indicated.

Optional Questionnaire: Tell us about your computer system.

Payment: Annual dues are:

U.S. (Domestic)	Canada & Mexico*	International*
$18	$20	$28

*U.S. FUNDS

Mailing: Mail this form and your check or money order (no cash, please) to:

Heath User's Group
Hilltop Road
Saint Joseph, MI 49085

NO REVOLVING CHARGE OR BILLINGS ARE ACCEPTED

597-1656-01

Courtesy Zenith Data Systems

TM 4

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Support Group Information

ZENITH data systems

SERVICE INFORMATION

In the event service is required on any ZENITH DATA SYSTEMS Computer Hardware Products, please refer to:

- Listing of Authorized Zenith Data Systems Service Stations accompanying the product.
- ZENITH DATA SYSTEMS Authorized Service Stations – In the Yellow Pages under "Data Processing Equipment".
- HeathKit Electronic Centers – In the White Pages or in the Yellow Pages under "Data Processing Equipment".

If you are unable to locate a service station locally, call ZENITH DATA SYSTEMS, Customer Services Assistance:

Area Code (312) 671-7550

If service is not available locally, or if you wish, arrangements can be made to return your Computer Hardware Products to the factory for service. For your protection, you must obtain a Return Authorization Number from the Factory Service Station before your Computer Hardware Products are returned. The Return Authorization Number must appear on the carton and packing list in order to expedite processing through the factory service center. To obtain a Return Authorization Number, please contact:

ZENITH DATA SYSTEMS
Service Department
11000 Seymour Ave.
Franklin Park, Il 60131
(312) 671-7550

If you are shipping your Computer Hardware Products to the Factory Service Station, it must be returned in the original shipping materials for proper protection, transportation prepaid, to the above address. If you no longer have the shipping materials, you may contact the Factory Service Station and arrangements will be made to ship the materials to you. We regret, we must charge you for this service.

In addition to the Return Authorization Number, remember to include a copy of your proof of purchase with the product in order to substantiate warranty.

You will be notified of any charges prior to servicing on any items that are out of warranty or do not have proof of purchase.

Courtesy Zenith Data Systems

PUBLICATIONS AND RESOURCES
UNIT VIII

ASSIGNMENT SHEET #1 — SELECT RESOURCES TO HELP SOLVE MICROCOMPUTER SERVICE PROBLEMS

Directions: Read the following situations carefully and recommend the resource that would best help solve the problem.

A. A customer wants to know what options are available for selecting a printer. Where should this individual go for the most reliable information?

Answer ______________________________

B. A repair technician has found a problem that none of the workers can help with, and there is no reference to the problem in the product *User's Manual* or any technical manuals for the equipment. Where can the technician get the quickest, most reliable help?

Answer ______________________________

C. A technician wants to know where the driver for a printer stepper motor is located. What would be the best references?

Answer ______________________________

D. A customer wants to know if there is any free software available for an Apple computer. What resource should be recommended?

Answer ______________________________

E. A technician wants to know if the manufacturer will pay for all or part of the cost for repairing a printer that will not return to the home position at power up. What resource will provide the best information?

Answer ______________________________

F. A customer wants to know what new software is available to help conduct a fabric store business on an IBM PC. What's the best resource for this information?

Answer ______________________________

PUBLICATIONS AND RESOURCES
UNIT VIII

ASSIGNMENT SHEET #2 — CONDUCT A SURVEY OF A LOCAL USER'S GROUP

Directions: Your instructor will provide you with the name of a member of a local or area user's group along with a telephone number and/or time when the person will be free. Work with other students as selected by your instructor, call or visit the user group member, complete the following survey, and then report the results of your survey to the class. Ask additional questions as you see fit, and be sure to note any interesting comments the user member makes in addition to the questions asked.

1. What is the name and address of the user group?

   ____

2. When and where does the group hold formal meetings?

   ____

3. Does the group have a hot line, and if so, what is it?

   ____

4. Do any group members do their own microcomputer or peripheral troubleshooting and repairs, and if so, to what degree?

   ____

   ____

5. What are the five most common problems with the microcomputer the group supports (listed in order of importance)?

   ____

   ____

   ____

   ____

   ____

ASSIGNMENT SHEET #2

6. What is the most popular printer among user members?

7. What are the most common problems with the printer named above?

8. Is technical support available for the printer named above, and is there a hot line service for printer troubles, and if so, what is the number?

9. What is the most popular disk drive among user members, if drive selection is optional?

10. What is the most common problem with disk drives in general among group members?

11. What peripherals besides printers and disk drives do group members seem to favor?

12. How many group members find the user's manual that came with their computers to be complete and effective (expressed in percent)?

13. What is the most unusual problem a group member has ever experienced with this brand of microcomputer?

14. What is the most unusual problem a group member has experienced with a printer?

ASSIGNMENT SHEET #2

15. What is the most unusual problem a group member has ever experienced with a disk drive?

16. How do group members feel about available repair service for their microcomputers and peripherals?

17. How many members of the group have purchased diagnostic software for use in troubleshooting either their microcomputers, printers, or disk drives (expressed in percent)?

18. What generally is the response members have had to diagnostic software?

19. What do members feel is the best diagnostic software for their brand of microcomputer?

20. What do members feel is the best diagnostic software for the most common types of disk drives the group uses?

21. What do members feel is the best diagnostic software for the most common type of printer the group uses?

22. Do any group members buy spare parts for their equipment, and if so, where do they buy and how is the service?

ASSIGNMENT SHEET #2

23. What kind of service has the group in general had from the computer store(s) where they bought their equipment?

____

____

____

24. What value would a repair technician gain from joining a local or area user's group?

____

____

PUBLICATIONS AND RESOURCES
UNIT VIII

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

A. The user's manual

B. The support group

C. A block diagram, wiring diagram, or a schematic

D. A user group

E. The warranty

F. A trade journal, especially one dedicated to that specific product

Assignment Sheet #2

Evaluated to the satisfaction of the instructor

PUBLICATIONS AND RESOURCES
UNIT VIII

NAME ______________________

TEST

1. Match the terms on the right with their correct definitions.

______a. Any service performed at other than a repair center designated by the OEM

______b. A telephone number known only to selected persons who may use the number for emergency or information services

______c. Original equipment manufacturer

______d. A magazine or newspaper dedicated to a general industry or occupation or a specific element within the industry or occupation

______e. Materials that are copyrighted and whose use may entail the payment of a fee which is usually included in the purchase price

______f. Materials that are not copyrighted and are available free for public use

______g. Individuals who join together at regular club meetings to exchange working experiences and otherwise share their mutual interest in a given brand of microcomputer

______h. A written statement that outlines the conditions of time and use under which a manufacturer will pay for repair or replacement of a piece of equipment that fails

1. Hot line
2. Trade journal
3. OEM
4. Field service
5. Warranty
6. User groups
7. Private domain
8. Public domain

2. Match equipment manuals with their characteristics.

______a. Should be supplied with computers, computer peripherals, and testing and laboratory equipment, and if they are not supplied with the equipment, they should be ordered from the manufacturer

______b. Are normally only available to the software buyer, so when troubleshooting indicates a software problem, the customer should be notified it is not a service problem

1. Software manuals
2. Maintenance manuals
3. User manuals
4. Technical manuals

TEST

_____c. Sometimes come with original equipment, but frequently have to be purchased from the manufacturer, and often are released to companies who have representatives attend computer repair schools run by manufacturers

_____d. These are extended tech manuals that contain specific information about testing, hooking up instrumentation equipment, disassembly and reassembly of components, and repair hints and procedures

3. Complete statements concerning schematics and troubleshooting guides by inserting the word(s) that best completes each statement.

   a. Schematics and troubleshooting guides are published by many manufacturers of disk drives, printers, video display units,and other peripherals, and these materials are necessary to facilitate ____________ and ____________ ____________ troubleshooting

   b. Another excellent source of ____________ and ____________ guidelines is Computerfacts™

   c. Computerfacts are available for most of the ____________ brands of microcomputers, disk drives, printers, and video display units

   d. Major components in a typical Computerfacts include:

      1) A list of preliminary ____________ checks

      2) Schematics including ____________ notations for waveforms, voltages, and ____________ identification

      3) Step by step ____________ guides

      4) A component by component ____________ list

      5) Excellent ____________ with map-type grid references to help locate components quickly

      6) A ____________ chart to assist in finding faulty circuitry with a logic probe

4. Select true statements concerning warranties by placing an "X" in the appropriate blanks.

_____a. When reading a warranty, it is important to determine the nature of any field service that would invalidate all or part of the warranty

_____b. Most warranties specify what areas of the equipment are the province of the manufacturer only, and these restricted areas should be left alone

TEST

_____c. Examine warranties carefully to determine under what conditions seals can be broken

_____d. Examine time limits on warranties carefully because they vary with dealers, and careless reading of a warranty can lead to unpleasant customer relations

5. Complete the following statements concerning block diagrams and wiring diagrams by inserting the word(s) that best completes each statement.

   a. Both block diagrams and wiring diagrams should be found in the ____________ manuals and/or ____________ manuals

   b. Block diagrams give general ____________ ____________ information and wiring diagrams give detailed patterns of wiring ____________ components in a system

   c. Appropriate diagrams should always be consulted ____________ ____________ and ____________ troubleshooting routines

6. Complete the following statements concerning trade journals by inserting the word(s) that best completes each statement.

   a. Almost every microcomputer on the market has ____________ or ____________ trade journals which supports the microcomputer or a particular product line

   b. The more popular microcomputers have not only one ____________ journal but four, five, or six trade journals that support them

   c. In some cases, a trade journal will support a microprocessor ____________ instead of a specific microcomputer

   d. Trade journals are ____________ good sources for troubleshooting tips, and especially good sources for input from computer users who have solved ____________ problems or have ____________ problems that need solving

7. Select true statements concerning user groups by placing an "X" in the appropriate blanks.

_____a. User groups exist at the national, state, and local levels

_____b. National and state user groups are good places to obtain libraries of software and information about new products, hardware, software, and special applications

_____c. The most useful of the user groups is at the national level where people with the same kind of equipment use their combined knowledge to solve problems

_____d. Some user groups have hot lines reserved for members only

_____e. Members of user groups are good people to know because they can best identify problems common to one microcomputer and that computer's behavioral characteristics with certain peripherals

TEST

8. Complete the following statements concerning support groups by inserting the word(s) that best completes each statement.

   a. Support groups are _____________ groups linked to the manufacturers of computers, and both hardware and software

   b. Some support groups have a hot line service where _____________ owners of their specific product line can call for help

   c. Technical support groups can be very useful for _____________ equipment problems, and hot line numbers that can be used should be listed where they will be available as needed

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

9. Select resources to help solve microcomputer service problems. (Assignment Sheet #1)

10. Conduct a survey of a local user's group. (Assignment Sheet #2)

PUBLICATIONS AND RESOURCES
UNIT VIII

ANSWERS TO TEST

1. a. 4
   b. 1
   c. 3
   d. 2
   e. 7
   f. 8
   g. 6
   h. 5

2. a. 3
   b. 1
   c. 4
   d. 2

3. a. Better, more efficient
   b. Schematics, troubleshooting
   c. Popular
   d. 1) Service
      2) Standard, stage
      3) Troubleshooting
      4) Parts
      5) Photographs
      6) Logic

4. a,b,c

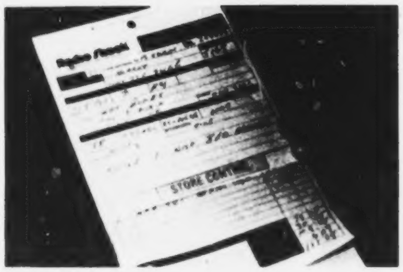
5. a. User, technical
   b. Flow-type, between
   c. Prior to, during

6. a. One, more
   b. Support
   c. Type
   d. Sometimes, peculiar, peculiar

7. a,b,d,e

8. a. Technical
   b. Registered
   c. Specific

9.-10. Evaluated to the satisfaction of the instructor



CUSTOMER RELATIONS AND RECORD KEEPING
UNIT IX

UNIT OBJECTIVE

After completion of this unit, the student should be able to list workplace requirements for dress and behavior, itemize elements of a good customer conference, and discuss the need for good records in the microcomputer repair industry. The student should also be able to conduct a customer conference and properly fill out a service order. These competencies will be evidenced by correctly completing the procedures outlined in the assignment sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to customer relations and record keeping with their correct definitions.
2. Complete statements concerning guidelines for personal appearance.
3. Complete a list of BE attitudes for successful technicians.
4. Complete a list of general guidelines for conducting a customer conference.
5. Complete a list of specific information to look for in a customer conference.
6. Complete a list of important matters to clarify before repairs begin.
7. Select true statements concerning requirements for record keeping.
8. Complete statements concerning the procedure for returning equipment.
9. Complete statements concerning troubleshooting and repair logs.
10. Match persons who use records with the ways they use them.
11. Complete a list of other skills that promote advancement.
12. Select true statements concerning service contracts.
13. Complete a list of obvious candidates for service contracts.
14. Complete a list of obvious candidates for system upgrades.
15. Select true statements concerning guidelines for service calls.
16. Conduct a customer conference. (Assignment Sheet #1)

OBJECTIVE SHEET

17. Fill out a service order. (Assignment Sheet #2)
18. Advise a customer concerning repair costs. (Assignment Sheet #3)

CUSTOMER RELATIONS AND RECORD KEEPING
UNIT IX

SUGGESTED ACTIVITIES

A. Provide student with objective sheet.

B. Provide student with information and assignment sheets.

C. Make transparencies.

D. Discuss unit and specific objectives.

E. Discuss information sheet.

F. Read carefully and then prepare the special materials required for Assignment Sheet #1 by giving each student a typical problem to report, and have the students pair off and role play customer conferences.

G. Obtain sample copies of service orders or other record keeping documents that a local or area computer repair center uses and show these to the class in conjunction with the activities outlined in the assignment sheets.

H. Give test.

CONTENTS OF THIS UNIT

A. Objective sheet

B. Information sheet

C. Transparency masters

  1. TM 1 — Service Order

  2. TM 2 — Shipping/Receiving Record

  3. TM 3 — Troubleshooting and Repair Log

D. Assignment sheets

  1. Assignment Sheet #1 — Conduct a Customer Conference

  2. Assignment Sheet #2 — Fill Out a Service Order

  3. Assignment Sheet #3 — Advise a Customer Concerning Repair Costs

E. Answers to assignment sheets

F. Test

G. Answers to test

REFERENCES USED IN DEVELOPING THIS UNIT

A. *Occupational Outlook Quarterly.* Washington, DC 20212: U.S. Department of Labor, Bureau of Labor Statistics, Spring 1984.

B. *Occupational Outlook Handbook.* Washington, DC 20212: U.S. Department of Labor, Bureau of Labor Statistics, April 1982.

CUSTOMER RELATIONS AND RECORD KEEPING
UNIT IX

INFORMATION SHEET

I. **Terms and definitions**

- A. Downtime — Any period of time a microcomputer system is out of operation for purposes of maintenance or repair
- B. FIFO — First in, first out
- C. Inventory — The number of parts and components physically stocked by the store for retail sale or repair use
- D. Priority — The order in which service orders are handled
- E. Service call — Maintenance, troubleshooting, or repair work done at a customer's business or residence
- F. Service order — A formal document used to keep track of general business activity, repair activity, and technician performance

II. **Guidelines for personal appearance**

- A. Bathe or shower daily, brush your teeth regularly, use deodorants if you perspire easily, and generally pay attention to matters of personal hygiene
- B. Keep your hair clean and properly groomed so that it will not be a problem in the workplace

  (NOTE: Combing or brushing hair around computer equipment is strictly forbidden, and hair spray should never be used around computer equipment.)
- C. Develop personal habits that promote good health because poor personal health can adversely affect how you look and feel at work, and most of all, how you perform at work
- D. Select clothes that are casual and comfortable, but avoid extremes of formal dress or outright sloppy dress
- E. Wear coordinated colors but avoid combinations of colors that clash or flashy colors that are inappropriate
- F. Select shoes that are comfortable because there may be times when you're on your feet for extended periods

  (NOTE: Sneakers may be comfortable, but they're not recommended for persons who have to meet the public so stick with comfortable dress shoes, casual shoes, or loafers.)

INFORMATION SHEET

G. Whether in the store or on a service call, the attention you pay to your personal appearance will become a part of the store image

III. **BE attitudes for successful techniques**

A. Be punctual — Get to work on time, make arrangements as far in advance as possible when you know you're going to be absent, and call in promptly when you're ill and can't go to work

B. Be work oriented — Work when you're supposed to be working, don't stretch break periods or lunch periods, and do not use the workplace for personal activities, especially phone calls from or to friends or family unless they are emergencies

C. Be careful — When troubleshooting, always have a reason for what you do because a haphazard approach will waste valuable time and create more problems than were present to start with

D. Be honest — If you can't fix it, pass it on to someone qualified to handle the problem before you fool around and damage it

E. Be record conscious — Develop the habit of using proper forms and writing down what you do, what you use, and all information that may help you or others in future troubleshooting

IV. **General guidelines for conducting a customer conference**

A. Exercise tact and diplomacy

B. Listen to the customer

C. Look at the customer when he or she is talking

D. Write down all information that helps define the problem

E. Talk to the customer in language the customer can understand

F. Make no rash promises about how fast a repair can be made or how little it might cost

G. Keep your language and your attitude positive and leave the customer on a positive note

V. **Specific information to look for in a customer conference**

A. What happened just before the problem occurred?

B. For what specific purpose was the system being used at the time the problem occurred?

INFORMATION SHEET

C. Has anyone other than the usual operator used the system at a time close to the malfunction?

D. In what kind of environment is the computer used?

E. Has the problem occurred before?

F. Have the microcomputer or peripherals been recently added to or changed in any way?

G. Has the customer attempted to repair the problem personally?

H. How was the system configured when the problem occurred?

VI. **Important matters to clarify before repairs begin**

A. Whether or not the micro or the peripheral is in or out of warranty

B. That the cost of repairs is only an estimate and will vary according to the complexity of the problem and need for replacement parts

C. That time needed for repairs is also an estimate and subject to the availability of parts

D. That the customer will pay for repairs at the time equipment is picked up

VII. **Requirements for record keeping** (Transparency 1)

A. Service orders must have a serial number to serve as a control number for the various departments within the store

B. Service orders must clearly identify the customer by name, address, and list a telephone number where the customer may be called

C. Service orders should include all identifying numbers such as model #, serial #, catalog #, or the service contract # if repairs are so contracted

D. The service order should also indicate whether the equipment is in or out of warranty

E. No service order is complete until at least a brief written statement of the problem is written onto the order and initialed by the customer

F. The customer should sign the service order to indicate his or her understanding of how payments for repairs should be made and the disposition of equipment that is not picked up

G. Use a sturdy ball point when writing repair orders and press hard because most records are in triplicate (or more) and information on all copies needs to be legible

INFORMATION SHEET

H. Any information gathered in the customer conference that would be vital to a service technician should be written on the service order itself or stapled to the service order

I. All items shipped to other repair centers should be documented properly not only for bookkeeping purposes but for keeping track of customer property and simply knowing where things are and how long they've been there (Transparency 2)

VIII. **Procedure for returning equipment** (Transparency 2)

A. Make sure you have a RETURN AUTHORIZATION for the equipment

B. If the RETURN AUTHORIZATION is a form that must be filled out, make sure it is completely filled out

C. If the RETURN AUTHORIZATION is only a verification number taken by phone from a repair center, make sure the RA number is somewhere with the equipment

D. Remember that repair centers are busy places and that equipment received without a RETURN AUTHORIZATION is usually set aside and becomes impossible to trace

E. Clear up any questions about warranties before shipping equipment that is assumed to still be under warranty

IX. **Troubleshooting and repair logs** (Transparency 3)

A. Keeping track of the time a technician spends servicing or repairing equipment is usually accomplished with a troubleshooting or repair log

B. A good troubleshooting log should repeat the customer's name, the service order or invoice number, and the nature of the complaint

C. The log should also contain an itemized account of all replacement parts used so that inventory can be kept in proper supply

D. Time spent on a project is important because it determines how much a customer is billed, and is also a measure of a technician's productivity

X. **Persons who use records and ways they use them**

A. Bookkeepers — To keep track of income and expenses, prepare payroll, figure taxes, and generally keep track of all business activity and inventory

B. Repair technicians — To keep track of all the number, type, and serial numbers of replacement parts used and the amount of time required for troubleshooting and repair

INFORMATION SHEET

C. Managers and owners — To plan business activity, maintain quality control, and evaluate technicians according to productivity in terms of units per hour, cost per hour, and number of units returned for redo

(NOTE: Since almost all computer stores guarantee repairs for at least thirty days, many stores require that returns be redone at no charge by the technician that made the repairs in the first place.)

D. Customers — To be aware of the nature of the problem, what parts were required, how long it took to repair the problem, and the cost of the services

XI. **Other skills that promote advancement**

A. The ability to recognize customers who could benefit from a service contract and either sell them a service contract or guide them to a person who can

B. The ability to advise customers who need system upgrades on the nature of the problems and the equipment required to solve them

C. An instinctive awareness of the power of microcomputer systems and what they can accomplish for the individuals and businesses who buy and use them

XII. **Service contracts**

A. A service contract is an agreement between a computer store and an individual or business to pay a certain amount per month to have repair service guaranteed

B. Service contracts generally include free replacement of common parts such as fuses, resistors, and capacitors, but usually require the customer to pay for or share the cost of replacing major components

C. Service contracts usually provide a preventive maintenance schedule that will significantly help reduce downtime and increase personal or business productivity

D. Service contracts frequently provide priority service so that troubles are corrected on the spot or as soon as possible

E. Service contracts sometimes provide "loaner" systems or peripherals to keep a system operating while repairs are being completed

XIII. **Obvious candidates for service contracts**

A. Bookkeeping businesses or individual accountants who use their systems daily for extended periods of time

B. Businesses or individuals for whom downtime would mean a significant loss of income or a significant inconvenience

INFORMATION SHEET

C. Businesses or individuals who use systems in restricted environments or for classified activities

(NOTE: The whole idea here is to guarantee the business or individual that any technician sent to perform service will respect the restricted nature of the business, or if required, have a documented security clearance.)

D. Businesses far remote from repair facilities

E. Any business that operates a system 24 hours a day, seven days a week

(NOTE: A contract for such a business will always include a prime and standby number where the business can call for help any hour of the day or on weekends.)

XIV. **Obvious candidates for system upgrades**

A. Customers whose systems are loaded with so many add-ons that it has created perpetual problems with overloads and overheating

B. Customers faced with repair costs close to or beyond the cost of the original equipment

C. Customers who bought low-cost, minimal-memory microcomputers and are faced with excessive costs for expansion and interfacing devices to accomplish what they need or want to do

D. Customers who are faced with a need for equipment large enough or with the design features required to operate sophisticated software

E. Customers who simply want to improve their programming skills and need equipment equal to the ambition

XV. **Guidelines for service calls**

A. When it is more convenient to conduct troubleshooting and repair activities at a site remote from the store, plan for what is needed so the wasted time and expense of a second trip will not be required

B. For field service, take along a complete emergency parts kit, and known good components for the type of system to be worked on

C. On all service calls, take the service order with you and know the name of the party who requested or authorized the service

D. Respect individual and business premises by not smoking, by keeping the work area as clean as possible, and by not interrupting others who may be at their daily jobs

INFORMATION SHEET

E. If the service call is for a system that is under a service contract, or one that the company has worked on before, check past service records for clues to the problem

F. When driving company vehicles, obey all traffic laws, and keep the vehicles clean because they create good or bad company images depending on how they look

G. Conduct yourself on a service call with one thing in mind: how you look and function is the same impression the customer will have of the company as a whole

Service Order

MIDDLETOWN COMPUTER SALES AND SERVICE
1 Main Street
Middletown, USA
(444) 444-8088

SERVICE ORDER No. 4478

Received by: ______________________

Seller Us ☐ Other ☐
Warranty In ☐ Out ☐

Customer's Name: ______________________
Address: ______________________
City: ______________________ State __________ Zip __________
Telephone: ______________________ Date In: ______________________
Equipment type: ______________________ Model #: __________ Serial #: __________
Condition of equipment: ______________________ Peripherals: ______________________
Nature of complaint(s): ______________________

Check here if customer has a service contract ☐
Check here if additional information is attached to this service order ☐
Check here if customer wants estimate before work begins ☐

ACCOUNTING CONTROL COPY

Date to shop: ______________________ Tech ID: ______________ Time On: ____________
Time Off: ____________

	Qnty	@	Subtotal:
Parts Used:			

Check here if this is an estimate ☐
Check here if this is a final bill ☐

REPAIR SHOP COPY 4478

Parts Total: ____________
____
Labor Total: ____________
Subtotal: ____________
Tax: ____________
Total: ____________

CUSTOMER RECEIPT 4478

Customer agrees to pay for estimates on the basis of a minimum one-half hour at regular service rates, to pick up equipment promptly upon notification that it is ready, and to bear all responsibilities for procedures that must be taken to dispose of ready equipment left more than 45 days.

CUSTOMER SIGNATURE: ______________________ Date: ______________

TM 1

Shipping/Receiving Record

OUT-OF-STORE REPAIR LOG

Month ________________ **Year** ____________

Packed By	Service Order # and Customer	Equipment Type and Serial #	Shipped To	Date Out	Date Ret'd	Return Authorization

Troubleshooting and Repair Log

Troubleshooting and Repair Log

Customer's Name ______________________________ Invoice __________________

Date ____________________ Equipment and Serial # ____________________________

Complaint ____

____

Technician's Name & ID #	Date	Time On	Time Off	Work Performed	Replacement Parts Used & Inventory #

CUSTOMER RELATIONS AND RECORD KEEPING
UNIT IX

ASSIGNMENT SHEET #1 — CONDUCT A CUSTOMER CONFERENCE

Directions: Your instructor has given one of your fellow students a typical problem that a customer might have with a microcomputer or a peripheral. Pretend that the other student is a customer for service or repair and conduct an interview with him or her to gather information necessary for the service or repair work to be properly started. Write your questions out in advance, and write in those parts of the answers you consider vital. Your interview will be evaluated on your ability to gather not only sufficient customer information, but information pertinent to the equipment. For the sake of easy reference, number each entry you make.

#1

ASSIGNMENT SHEET #1

CUSTOMER RELATIONS AND RECORD KEEPING
UNIT IX

ASSIGNMENT SHEET #2 -- FILL OUT A SERVICE ORDER

Directions: Using the following hypothetical information, fill out the accompanying service order properly.

Situation: A customer who has a microcomputer with a history of overheating problems brings in the microcomputer to have it checked over. During the customer interview, you find that the customer hadn't used the equipment for more than a week and that when it was turned on, it worked just long enough for the DOS to boot up the system, and then it stopped working and the customer couldn't get it to do anything after that. The customer says that he had the system hooked up to his disk drive and printer just like he always uses it, and that the DOS is the same one he has always used. He does remember smelling something unusual just before the system went on the blink.

The customer is aware that his warranty ran out about ten days before the trouble happened, but he says he was out of town during the period and not using the system so the warranty should still be in force.

The customer is so sure that the problem is only with the microcomputer that he didn't bring in the disk drive or the DOS.

By the way, the microcomputer is BIG BOY, Model I, serial #12345. The customer also talks about how slowly the thing runs since he added the new RGB drive card and that he wishes he had bought a bigger system to begin with.

The customer then says he has to rush off, but would like to know when the computer will be repaired and about how much it will cost.

Fill out the accompanying service order, and then go on to Assignment Sheet #3 and use this information to answer the questions there.

Oh, by the way, the customer is Joe Jones who lives at 111 First Street, Middletown, USA 74071, and his phone is 444-444-1212.

The microcomputer is evidently covered with dust, and oh yes, it's August 19, 1986, and your name is Ben Ready. Good luck, Ben! Considering this guy bought his equipment at some other store, it's a good place for you to start learning customer relations!

ASSIGNMENT SHEET #2

MIDDLETOWN COMPUTER SALES AND SERVICE

1 Main Street
Middletown, USA
(444) 444-8088

[illegible]

Received by:

Customer's Name:

Seller Us ☐ Other ☐

Address:

Warranty In ☐ Out ☐

City:

State

Zip

Telephone:

Date In:

Equipment type:

Model #:

Serial #:

Condition of equipment:

Peripherals:

Nature of complaint(s):

Check here if customer has a service contract ☐

Check here if additional information is attached to this service order ☐

Check here if customer wants estimate before work begins ☐

[illegible]

Date to shop:

Tech ID:

Time On:

Time Off:

Parts Used:	Qnty	@	Subtotal:

Check here if this is an estimate ☐
Check here if this is a final bill ☐

[illegible]

Parts Total:

Labor Total:

Subtotal:

Tax:

Total:

[illegible]

Customer agrees to pay for estimates on the basis of a minimum one-half hour at regular service rates, to pick up equipment promptly upon notification that it is ready, and to bear all responsibilities for procedures that must be taken to dispose of ready equipment left more than 45 days.

CUSTOMER SIGNATURE:

Date:

CUSTOMER RELATIONS AND RECORD KEEPING
UNIT IX

ASSIGNMENT SHEET #3 — ADVISE A CUSTOMER CONCERNING REPAIR COSTS

Directions: The BIG BOY I microcomputer in Assignment Sheet #2 will cost more than $300 to repair because it needs a new power supply and new ROM. Review the information in Assignment Sheet #2, consider the repair estimate, and then answer the following questions.

1. Joe Jones is an obvious candidate for what?

   Answer ______________________________

2. Is Joe's BIG BOY I out of warranty?

   Answer ______________________________

3. What makes you think Joe might be a frequent microcomputer user?

   Answer ______________________________

4. Does Joe need any advice about his microcomputer environment?

   Answer ______________________________

5. Since Joe's BIG BOY I cost only $399 new, does this affect what you probably should talk to Joe about, and if so, why?

   Answer ______________________________

CUSTOMER RELATIONS AND RECORD KEEPING
UNIT IX

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

(NOTE: The order may vary, but the customer conference should contain most of the following information to be satisfactory.)

1. The customer's name, address, and a telephone number where the customer can be reached.
2. Whether or not the equipment is still in or out of warranty.
3. What happened just before the problem occurred.
4. For what purpose was the system being used at the time the problem occurred.
5. Was anyone else other than the usual operator using the system at the time of failure or close to that time?
6. Has the problem occurred before?
7. Has the customer attempted to repair the problem him/herself?
8. Have there been any recent changes to the system?
9. How was the system configured at the time the problem occurred?

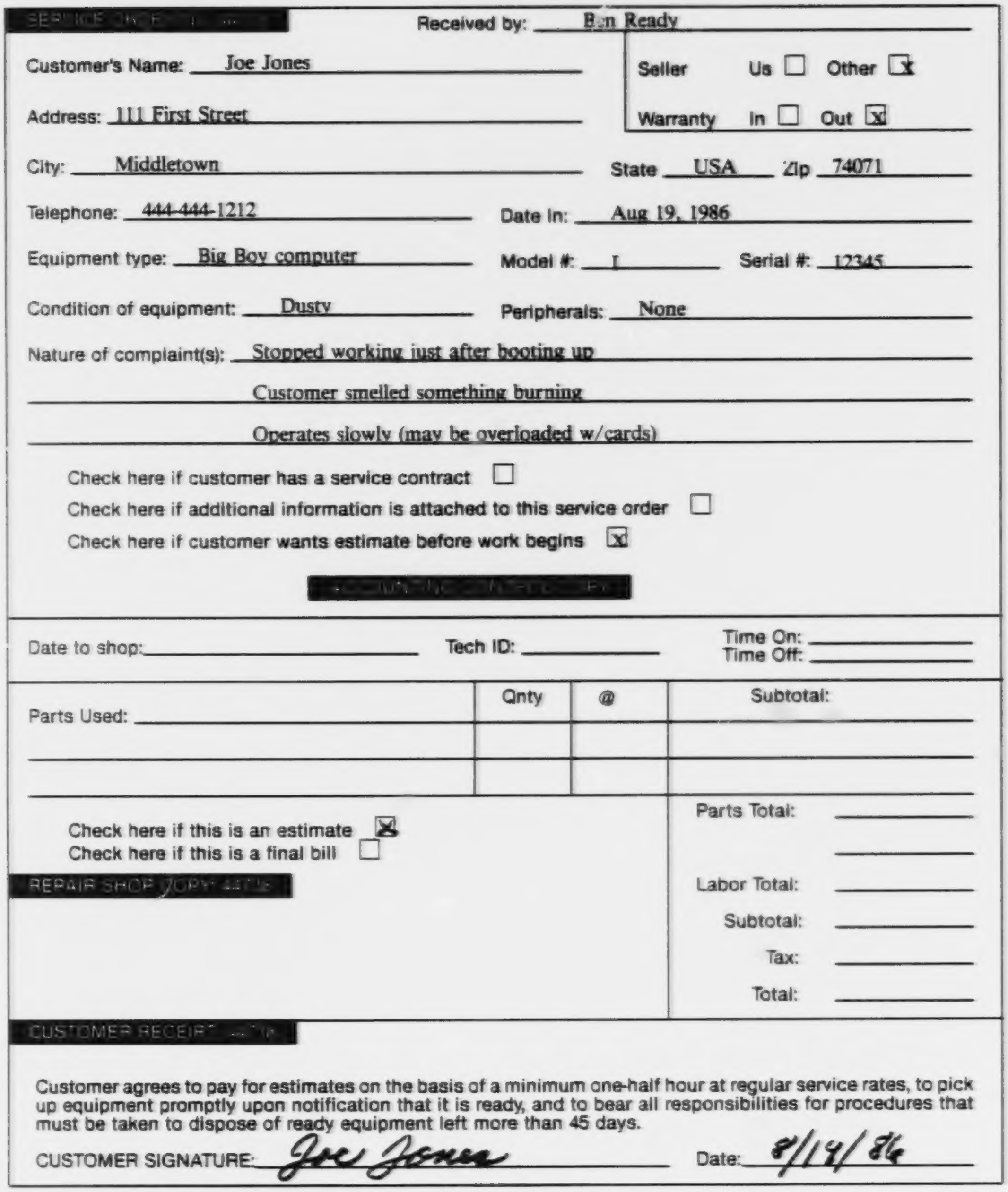
(NOTE: If the interview contains at least three of the following items, it is exceptional.)

10. Whether or not the customer has a service contract with the company.
11. What kind of environment the system is used in.
12. Whether or not the problem involves software.
13. An estimate of repair cost, repair time, and how the repairs will be paid for.
14. THE CUSTOMER'S SIGNATURE.
15. Identifying serial numbers of the equipment that will be left for service or repair.

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #2

MIDDLETOWN COMPUTER SALES AND SERVICE
1 Main Street
Middletown, USA
(444) 444-8088



SERVICE ORDER [illegible]

Received by: Ben Ready

Customer's Name: Joe Jones

Seller Us ☐ Other ☒

Address: 111 First Street

Warranty In ☐ Out ☒

City: Middletown State USA Zip 74071

Telephone: 444-444-1212 Date In: Aug 19, 1986

Equipment type: Big Boy computer Model #: I Serial #: 12345

Condition of equipment: Dusty Peripherals: None

Nature of complaint(s): Stopped working just after booting up
Customer smelled something burning
Operates slowly (may be overloaded w/cards)

Check here if customer has a service contract ☐
Check here if additional information is attached to this service order ☐
Check here if customer wants estimate before work begins ☒

ACCOUNTING CONTROL COPY

Date to shop: Tech ID: Time On: Time Off:

	Qnty	@	Subtotal:
Parts Used:			

Check here if this is an estimate ☒
Check here if this is a final bill ☐

REPAIR SHOP COPY [illegible]

Parts Total:
Labor Total:
Subtotal:
Tax:
Total:

CUSTOMER RECEIPT [illegible]

Customer agrees to pay for estimates on the basis of a minimum one-half hour at regular service rates, to pick up equipment promptly upon notification that it is ready, and to bear all responsibilities for procedures that must be taken to dispose of ready equipment left more than 45 days.

CUSTOMER SIGNATURE: Joe Jones Date: 8/19/86

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #3

1. An upgrade (and also a service contract).
2. Yes.
3. He has a history of overheating problems, a clue that he has too many add-ons that are overworking his system, so he uses his computer a significant amount and is obviously adding cards to make it do more than it was probably designed to do with its present power supply.
4. You bet. At the minimum, he needs dust covers for his equipment, and since dust suggests static electricity problems, he needs to look for a better computer room.
5. Putting more than $300 into an old system with a history of problems is not smart. The better investment is a new system big enough to do what Joe really probably wants a system to be able to do. With a knowledge of what Joe wants for special cards, the system can be tailor-made and save him not just a bunch of money, but a bunch of headaches.

   (NOTE: Student answers should approximate those given, but it is essential that the answers show the need for an upgrade and the two basic reasons for it — Cost of repairs to the old system and repeated problems with overheating.)

CUSTOMER RELATIONS AND RECORD KEEPING
UNIT IX

NAME ______________________

TEST

1. Match the terms on the right with their correct definitions.

_____a. Any period of time a microcomputer system is out of operation for purposes of maintenance or repair

_____b. First in, first out

_____c. The number of parts and components physically stocked by the store for retail sale or repair use

_____d. The order in which service orders are handled

_____e. Maintenance, troubleshooting, or repair work done at a customer's business or residence

_____f. A formal document used to keep track of general business activity, repair activity, and technician performance

1. FIFO
2. Service order
3. Downtime
4. Service call
5. Priority
6. Inventory

2. Complete the following statements concerning guidelines for personal appearance by inserting the word(s) that best completes each statement.

a. Bathe or shower daily, brush your teeth regularly, use deodorants if you perspire easily, and generally pay attention to matters of ____________ ____________

b. Keep your ____________ clean and properly groomed so that it will not be a problem in the workplace

c. Develop personal habits that promote good health because poor personal health can adversely affect how you look and feel at work, and most of all, how you ____________ at work

d. Select clothes that are casual and ____________, but avoid extremes of formal dress or outright sloppy dress

e. Wear ____________ colors but avoid combinations of colors that clash or flashy colors that are inappropriate

TEST

f. Select shoes that are comfortable because there may be times when you're on your feet for __________ __________

g. Whether in the store or on a service call, the attention you pay to your personal appearance will become a part of the __________ __________

3. Complete the following list of BE attitudes for successful technicians by inserting the word(s) that best completes each statement.

a. Be punctual — Get to work on time, make arrangements as far in advance as possible when you know you're going to be absent, and __________ __________ __________ when you're ill and can't go to work

b. Be work oriented — Work when you're supposed to be working, don't stretch break periods or lunch periods, and do not use the workplace for personal activities, especially phone calls from or to friends or family unless they are __________

c. Be careful — When troubleshooting, always have a __________ __________ __________ __________ __________ because a haphazard approach will waste valuable time and create more problems than were present to start with

d. Be honest — If you can't fix it, pass it on to someone qualified to handle the problem before you __________ __________ __________ __________ __________

e. Be record conscious — Develop the habit of using proper forms and __________ __________ what you do, what you use, and all information that may help you or others in future troubleshooting

4. Complete the following list of general guidelines for conducting a customer conference by inserting the word(s) that best completes each statement.

a. Exercise __________ and diplomacy

b. __________ to the customer

c. __________ at the customer when he or she is talking

d. __________ __________ all information that helps define the problem

e. Talk to the customer in __________ the customer can understand

f. Make no __________ __________ about how fast a repair can be made or how little it might cost

g. Keep your language and your attitude __________ and leave the customer on a positive note

TEST

5. Complete the following list of specific information to look for in a customer conference by inserting the word(s) that best completes each statement.

   a. What happened ____________ ____________ the problem occurred?

   b. For what ____________ ____________ was the system being used at the time the problem occurred?

   c. Has anyone ____________ ____________ ____________ ____________ used the system at a time close to the malfunction?

   d. In what kind of ____________ is the computer used?

   e. Has the problem occurred ____________?

   f. Have the microcomputer or ____________ been recently added to or changed in any way?

   g. Has the customer attempted to ______________________________ personally?

   h. How was the system ____________ when the problem occurred?

6. Complete the following list of important matters to clarify before repairs begin by inserting the word(s) that best completes each statement.

   a. Whether or not the micro or the peripheral is ____________ or ____________ of warranty

   b. That the cost of repairs is only an ____________ and will vary according to the complexity of the problem and need for replacement parts

   c. That ____________ needed for repairs is also an estimate and subject to the availability of parts

   d. That the customer will pay for repairs at the ____________ ____________ ____________ ____________ ____________

7. Select true statements concerning requirements for record keeping by placing an "X" in the appropriate blanks.

   _____a. Service orders must have a serial number to serve as a control number for the various departments within the store

   _____b. Service orders must clearly identify the customer by name, address, and list a telephone number where the customer may be called

   _____c. Service orders should include serial number of the part being replaced

TEST

______d. The service order should also indicate whether the equipment is in or out of warranty

______e. No service order is complete until at least a brief written statement of the problem is written onto the order and initialed by the customer

______f. The customer should not need to sign the service order

______g. Use a sturdy ball point when writing repair orders and press hard because most records are in triplicate and information on all copies needs to be legible

______h. Information gathered in the customer conference should be filed separately so it will not become confused with the service order

______i. Items shipped to other repair centers are usually handled on a contract basis

8. Complete the following statements concerning the procedure for returning equipment by circling the correct words.

   a. Make sure you have a (**service order, return authorization**) for the equipment

   b. If it is a form that must be filled out, make sure it is (**partially, completely**) filled out

   c. If it is only a (**verification number, person's name**) taken by phone from a repair center, make sure it is somewhere with the equipment

   d. Remember that repair centers are busy places and that equipment received without a return authorization is usually (**set aside, returned**)

   e. Clear up any questions about (**warranties, contracts**) before shipping equipment that is assumed to still be under warranty

9. Complete the following statements concerning troubleshooting and repair logs by inserting the words that best complete each statement. Several answers are possible.

   a. A good troubleshooting log should repeat the customer's name and ____________

   ____

   b. Time spent on a project is important because ____________________

   ____

TEST

10. Match persons who use records with the ways they use them.

______a. To keep track of income and expenses, prepare payroll, figure taxes, and generally keep track of all business activity and inventory

______b. To keep track of all the number, type, and serial numbers of replacement parts used and the amount of time required for troubleshooting and repair

______c. To plan business activity, maintain quality control, and evaluate technicians according to productivity in terms of units per hour, cost per hour, and number of units returned for redo

______d. To be aware of the nature of the problem, what parts were required, how long it took to repair the problem, and the cost of the services

1. Managers and owners
2. Customers
3. Repair technicians
4. Bookkeepers

11. Complete the following list of other skills that promote advancement by inserting the word(s) that best completes each statement.

a. The ability to recognize customers who could benefit from a ______________ ______________ and either sell them one or guide them to a person who can

b. The ability to advise customers who need ______________ ______________ on the nature of the problems and the equipment required to solve them

c. An instinctive awareness of the power of microcomputer systems and what they can accomplish for the individuals and ______________ who buy and use them

12. Select true statements concerning service contracts by placing an "X" in the appropriate blanks.

______a. A service contract is an agreement between a computer store and an individual or business to pay a certain amount per month to have repair service guaranteed

______b. Service contracts generally include free replacement of common parts such as fuses, resistors, and capacitors, and free replacement of major components

______c. Service contracts usually provide a preventive maintenance schedule that will significantly help reduce downtime and increase personal or business productivity

______d. Service contracts frequently provide priority service so that troubles are corrected on the spot or as soon as possible

______e. Service contracts sometimes provide "loaner" systems or peripherals to keep a system operating while repairs are being completed

TEST

13. Complete the following list of obvious candidates for service contracts by inserting the word(s) that best completes each statement.

    a. ____________ businesses or individual accountants who use their systems daily for extended periods of time

    b. Businesses or individuals for whom downtime would mean a significant ____________ ____________ ____________ or a significant inconvenience

    c. Businesses or individuals who use systems in restricted environments or for ____________ activities

    d. Businesses ____________ ____________ from repair facilities

    e. Any business that operates a system ____________ ____________ ____________ ____________, seven days a week

14. Complete the following list of obvious candidates for system upgrades by inserting the word(s) that best completes each statement.

    a. Customers whose systems are loaded with so many add-ons that it has created perpetual problems with ____________

    b. Customers faced with repair costs close to or beyond the cost of the ____________ ____________

    c. Customers who bought low-cost, minimal memory microcomputers and are faced with excessive costs for ____________ to accomplish what they need or want to do

    d. Customers who are faced with a need for equipment large enough or with the design features required to operate sophisticated ____________

    e. Customers who simply ____________ ____________ ____________ their programming skills and need equipment equal to the ambition

15. Select true statements concerning guidelines for service calls by placing an "X" in the appropriate blanks.

    _____a. When it is more convenient to conduct troubleshooting and repair activities at a site remote from the store, plan for what is needed so the wasted time and expense of a second trip will not be required

    _____b. For field service, take along a complete emergency parts kit, and known good components for the type of system to be worked on

    _____c. On all service calls, take the service order with you and know the name of the party who requested or authorized the service

    _____d. Respect individual and business premises by not smoking, by keeping the work area as clean as possible, and by not interrupting others who may be at their daily jobs

TEST

_____e. If the service call is for a system that is under a service contract, or one that the company has worked on before, the job is usually much easier

_____f. When driving company vehicles, obey all traffic laws, and keep the vehicles clean because they create good or bad company images depending on how they look

_____g. Conduct yourself on a service call with one thing in mind: how you look and function is the same impression the customer will have of the company as a whole

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

16. Conduct a customer conference. (Assignment Sheet #1)

17. Fill out a service order. (Assignment Sheet #2)

18. Advise a customer concerning repair costs. (Assignment Sheet #3)

CUSTOMER RELATIONS AND RECORD KEEPING
UNIT IX

ANSWERS TO TEST

1. a. 3
   b. 1
   c. 6
   d. 5
   e. 4
   f. 2

2. a. Personal hygiene
   b. Hair
   c. Perform
   d. Comfortable
   e. Coordinated
   f. Extended periods
   g. Store image

3. a. Call in promptly
   b. Emergencies
   c. Reasons for what you do
   d. Fool around and damage it
   e. Writing down

4. a. Tact
   b. Listen
   c. Look
   d. Write down
   e. Language
   f. Rash promises
   g. Positive

5. a. Just before
   b. Specific purpose
   c. Other than the usual operator
   d. Environment
   e. Before
   f. Peripherals
   g. Repair the problem
   h. Configured

6. a. In, out
   b. Estimate
   c. Time
   d. Time equipment is picked up

7. a,b,d,e,g

ANSWERS TO TEST

8. a. Return authorization
   b. Completely
   c. Verification number
   d. Set aside
   e. Warranties

9. a. One of the following:
      1) Service order or invoice number
      2) Nature of the complaint
      3) Itemized account of all replacement parts
   b. One of the following:
      1) It determines how much the customer is billed
      2) Is a measure of a technician's productivity

10. a. 4
    b. 3
    c. 1
    d. 2

11. a. Service contract
    b. System upgrades
    c. Businesses

12. a,c,d,e

13. a. Bookkeeping
    b. Loss of income
    c. Classified
    d. Far remote
    e. 24 hours a day

14. a. Overloads or overheating
    b. Original equipment
    c. Expansion or interfacing devices
    d. Software
    e. Want to improve

15. a,b,c,d,f,g

16. Evaluated to the satisfaction of the instructor

17. Evaluated to the satisfaction of the instructor

18. Evaluated to the satisfaction of the instructor

TROUBLESHOOTING
UNIT X

UNIT OBJECTIVE

After completion of this unit, the student should be able to discuss the techniques used in troubleshooting microcomputer systems and relate these techniques to effective troubleshooting routines. The student should also be able to use troubleshooting techniques and routines to identify problems with a microcomputer system and peripherals. These competencies will be evidenced by correctly performing the procedures outlined in the job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to troubleshooting with their correct definitions.
2. Complete a list of general guidelines for troubleshooting.
3. Complete statements concerning basic techniques for troubleshooting.
4. Complete statements concerning a typical forward to back troubleshooting routine.
5. Complete statements concerning sensory troubleshooting.
6. Arrange in order the steps in the first routine after sensory troubleshooting.
7. Complete statements concerning troubleshooting when the operating system will boot up.
8. Complete statements concerning troubleshooting when the operating system will not boot up.
9. Select true statements concerning intermittent problems.
10. Complete statements concerning intermittent and other problems related to overheating.
11. Complete statements concerning record keeping for module replacement.
12. Complete a list of ways to determine if a module should be replaced.
13. Select true statements concerning unloading the system.
14. Complete statements concerning hardware vs. software problems.
15. Complete a list of ways to handle media problems.
16. Select true statements concerning keyboard problems and lockouts.
17. Complete statements concerning troubleshooting monitor problems.

OBJECTIVE SHEET

18. Arrange in order the steps in correcting monitor problems.
19. Select true statements concerning monitors with screen RAM problems.
20. Complete statements concerning disk drive characteristics and problems.
21. Select true statements concerning troubleshooting disk drive motors.
22. Arrange in order the steps in removing disk drives.
23. Select true statements concerning steps in cleaning and lubricating disk drives.
24. Complete statements concerning troubleshooting disk drive speed problems.
25. Select true statements concerning steps in adjusting disk drive speed.
26. Complete statements concerning troubleshooting disk drive controller problems.
27. Select true statements concerning printer problems.
28. Complete statements concerning a basic printer troubleshooting routine.
29. Complete statements concerning common printer mechanical problems and their solutions.
30. Complete a list of steps in troubleshooting a computer that will not drive a good printer.
31. Select true statements concerning other areas of software/printer problems.
32. Complete statements concerning printer handshakes.
33. Demonstrate the ability to:
    a. Check voltage on a microcomputer power supply. (Job Sheet #1)
    b. Troubleshoot a microcomputer that will not boot up. (Job Sheet #2)
    c. Check and replace faulty modules in a microcomputer system. (Job Sheet #3)
    d. Troubleshoot a malfunctioning floppy disk drive. (Job Sheet #4)
    e. Troubleshoot a microcomputer keyboard. (Job Sheet #5)
    f. Troubleshoot a malfunctioning microcomputer monitor. (Job Sheet #6)
    g. Troubleshoot a malfunctioning printer. (Job Sheet #7)
    h. Discharge high voltage from a CRT. (Job Sheet #8)

TROUBLESHOOTING
UNIT X

SUGGESTED ACTIVITIES

A. Provide student with objective sheet.

B. Provide student with information and job sheets.

C. Discuss unit and specific objectives.

D. Discuss information sheet.

E. Discuss and demonstrate the procedures outlined in the job sheets.

F. Have students role play a customer conference so they can practice this very important first step in a repair order.

G. Read the job sheets carefully in advance and relate them to the equipment available for the students to work on, and disable equipment appropriately so that the troubleshooting routines will reflect actual problems technicians confront in repair facilities.

H. Emphasize safety elements required for testing power supplies and working around the video section of integrated systems, and emphasize that the procedures in Job Sheet #8 should not be attempted without supervision.

I. Demonstrate the requirements for properly handling boards, and emphasize the importance of handling them by the edges and handling them as little as possible.

J. Invite a local printer dealer to demonstrate to the class the procedures for changing a ribbon and a print head on a dot-matrix printer, and have the dealer discuss printer problems in general and how to approach them.

K. Invite a local disk drive dealer to talk about disk drive systems and how a diagnostic disk works with a specific system.

L. Give test.

CONTENTS OF THIS UNIT

A. Objective sheet

B. Information sheet

C. Job sheets

   1. Job Sheet #1 — Check Voltage on a Microcomputer Power Supply

   2. Job Sheet #2 — Troubleshoot a Microcomputer That Will Not Boot Up

CONTENTS OF THIS UNIT

3. Job Sheet #3 — Check and Replace Faulty Modules in a Microcomputer System

4. Job Sheet #4 — Troubleshoot a Malfunctioning Floppy Disk Drive

5. Job Sheet #5 — Troubleshoot a Microcomputer Keyboard

6. Job Sheet #6 — Troubleshoot a Malfunctioning Microcomputer Monitor

7. Job Sheet #7 — Troubleshoot a Malfunctioning Printer

8. Job Sheet #8 — Discharge High Voltage From a CRT

D. Test

E. Answers to test

REFERENCES USED IN DEVELOPING THIS UNIT

A. Brey, Barry D. *Microprocessor/Hardware Interfacing and Applications*. Columbus, OH 43216: Charles E. Merrill Publishing Company, 1984.

B. Brenner, Robert C. *IBM PC Troubleshooting and Repair Guide*. Indianapolis, IN 46268: Howard W. Sams & Co., Inc., 1985.

C. *How to Maintain and Service Your Small Computer*. Indianpolis, IN 46268: Howard W. Sams & Co., Inc., 1983.

D. Zumchak, Eugene. *Microcomputer Design and Troubleshooting*. Indianapolis, IN 46268: Howard W. Sams & Co., Inc., 1982.

E. Johnston, Chris. *The Microcomputer Builder's Bible*. Blue Ridge Summit, PA 17214: Tab Books Inc., 1982.

TROUBLESHOOTING
UNIT X

INFORMATION SHEET

I. **Terms and definitions**

A. Interaction problem — A problem involving both hardware and software

B. Intermittent problem — A problem that occurs only part of the time or at irregular intervals

C. Module — A general reference to a printed circuit board

D. Sensory — Having to do with the senses of seeing, hearing, feeling, and smelling

E. Systematic routine — A logical testing procedure used to isolate a problem with speed and reliability

II. **General guidelines for troubleshooting**

A. Use the customer conference to good advantage:

1. Listen carefully as the customer describes the problem, and keep notes of what the customer says

2. Try to determine what happened just before the malfunction, if the equipment has been subjected to unusual usage, if it has been recently moved, and questions pertinent to the problem described

3. Make sure notes from the customer conference are kept with the equipment or passed on to the technician who will work on the equipment

B. Try to duplicate the problem by setting up the equipment as it was being used to see if it will duplicate the problem described by the customer

C. Check for the obvious first — poorly connected or disconnected cables and plugs and blown fuses

D. Once a problem is verified, use the manufacturer's technical data or repair guide to set up a systematic troubleshooting routine, or, in the absence of technical guides, use a troubleshooting routine best suited for the problem

(NOTE: Microcomputer problems are often easy to repair, but difficult to track down and isolate, and since more than 80% of microcomputer repair time is spent on troubleshooting, working with standard routines is the best way to approach all types of malfunctions.)

INFORMATION SHEET

III. **Basic techniques for troubleshooting**

A. Forward to back — A technique whereby a component or subsystem is checked by starting at a terminating point (forward) and moving back to each critical point in sequence so the starting point is checked last

(NOTE: Back to forward is the same technique in reverse, and both of these techniques are useful when troubleshooting audio or video problems in a system.)

B. Half splitting — A technique whereby a known variable such as voltage or current is checked at the half-way point in a unit or subsystem, and if it is correct, one half of the system is eliminated as a problem and the other half is then split to isolate the problem in a given quarter of the system

(NOTE: Half splitting is both simple and fast, and a common technique in troubleshooting, but it is important that the variable selected for testing be a valid predictor of system operation, for it is isn't, the problem could be accidentally bypassed, and when half splitting fails to identify a problem, it does not always mean there is no problem; it could mean that the wrong variable was selected.)

C. Forward to back, back to forward, and half splitting are often used as techniques in basic troubleshooting routines, and in certain routines both the forward to back and half splitting are used together

D. Swapping components that are known to be good with components that are suspected of being faulty is another common technique in troubleshooting and ranges from swapping printers and disk drives to swapping boards and IC's

IV. **A typical forward to back troubleshooting routine**

A. Assuming that half splitting has isolated the problem to the audio system of the microcomputer, the procedure would be:

1. Start (forward) at the speaker or solid state sounder and inject a signal from an audio test generator

2. If the speaker or sounder reproduces the sound,

    a. Move back a stage, inject another audio test signal, and if the speaker or sounder reproduces the sound, it indicates that all points between that stage and the speaker are okay

    b. Move back another stage and repeat the procedure

3. If the speaker or sounder does not reproduce the sound,

    a. The trouble is isolated in the speaker or sounder

    b. The trouble is in the driver stage for the speaker

INFORMATION SHEET

B. An alternate to the forward to back routine is to start forward, but then start half splitting when checking back through the stages

(NOTE: Remember that half splitting can be properly injected into many routines to save time, and that's why it is a popular technique.)

C. Once the problem has been isolated to a specific printed circuit card, pull the card and replace it with a new one

V. **Sensory troubleshooting**

A. After a problem has been verified and cables, connections, and fuses have been checked, complete a sensory check of the equipment

B. *Look* to see if any parts are broken or missing or if any IC's, boards, cables, or other parts are loose

C. *Smell* the equipment for the obvious odors given off by burned transformers, capacitors, and resistors

(NOTE: Transformers, capacitors, and resistors all have unique smells when they burn out, and although the smells are difficult to describe, a troubleshooter with an average sense of smell will eventually be able to acquire the skill of smelling out the problem.)

D. *Listen* for unusual sounds from the equipment like the buzzing sound sometimes caused by a bad connection or just before a transformer goes out

(NOTE: Listen for other sounds too, like the "clicks" that indicate the audio section is working right and the interrupted "whirring" sound that may indicate a disk drive has a problem.)

E. The senses of sight, hearing, and smell are called upon often in troubleshooting, and with practice, all of these senses can become excellent troubleshooting tools

VI. **Steps in the first routine after sensory troubleshooting**

A. Check to see if the recommended voltage is present at the output of the power supply as indicated in the OEM tech manual

B. Use a voltmeter to make the voltage check and make sure it agrees with the output specified by the manufacturer

INFORMATION SHEET

C. If the voltage is significantly under or over, do not proceed until the power supply voltage is corrected, which may mean changing out the power supply

(CAUTION: Do not adjust any controls on the power supply modules, and if it should be a switching power supply, the power supply cannot normally be disconnected to make the check, so it must be checked with the load connected to the power supply, and it should be done with care.)

(NOTE: Switching power supplies are used on several new microcomputers such as the IBM PC and XT, Zenith 100 and 150, and Apple.)

D. Once correct voltage is established at the power supply, remove all external peripherals not required to evaluate the problem

E. Proceed with a half-splitting technique to isolate other subsystem problems

F. Remove all peripherals and turn the computer on

G. If the computer works, it means one or more peripheral devices are overloading the system

H. Add peripheral devices one at a time until you reach the one that causes the overload

I. Swap out the peripheral device causing the overload with a known good device and turn the computer back on

J. The computer and peripherals should work, and the faulty peripheral should be returned to a service center for repair

K. If all peripheral devices have been removed and the computer does not work when it is turned on again, swap out the main board and the computer should work

VII. **Troubleshooting when the operating system will boot up**

A. If the computer will boot up the operating system,

1. Read instructions for operating the diagnostic disk
2. Insert a diagnostic disk properly
3. Run diagnostics to check main board for normal ROM and RAM functions and certain I/O functions

INFORMATION SHEET

4. If diagnostics indicate ROM or RAM failure, replace ROM and/or RAM

   (NOTE: Most RAM diagnostics will pin the trouble down to the actual chip where the malfunction is located.)

5. Check keyboard by presenting keyboard pattern suggested by manufacturer, and press user keys to check for malfunctions

6. If key malfunction is discovered, replace the keyboard with a keyboard known to be in good operating condition

B. Use diagnostic disk to check the video system

1. If system is RGB, it will check for the presence of all colors and character and graphic generation capabilities

2. If the system is monochrome, it will check low, medium, and high resolution and character and graphic generation capabilities

C. Use the disk drive diagnostic to check the disk drive

(NOTE: Disk drive diagnostic disks are available from both the manufacturers of disk drives and from outside vendors.)

1. Test is simply a "go" or "no go" test and will indicate when the disk drive is not working right, but it won't indicate what the problem is

2. If test results in a "no go," then pull the disk drive and replace it with a disk drive known to be in good operating condition

VIII. **Troubleshooting when the operating system will not boot up**

A. Check the power supply for proper voltage, and make all visual and audio checks that can be made

B. Double check cable connections and make sure all parts are in place and properly seated

C. If the system will not initialize, the problem is probably in the CPU or the interrupts associated with the CPU

D. At this level of troubleshooting, changing out the CPU or the main board is the quickest and best course of action

E. If the system will initialize, but still fails to boot up the operating system, then:

1. Check the disk controller cards for proper voltage and be sure IC's are firmly seated

INFORMATION SHEET

2. Check the disk drive for proper voltage supply and good cable connections

3. Substitute known good parts for disk drive or disk controller card (or both), and this should get the system working

F. If the system will still not boot up the operating system after all voltage checks and controller card/disk drive substitution,

1. Change out the main board

2. If main board and CPU are separated, change out the CPU first and make a test, and change out main board only if needed

IX. **Intermittent problems**

A. Determine the part(s) of the system affected by the intermittent condition

Example: Does system fail to provide proper video part of the time, does the printer fail to print part of the time, or does the disk drive malfunction only part of the time?

B. Isolate the part, then check all connections

1. Cable connections

2. Connections on pluggable components

3. Printed circuit board connections

C. The intermittent condition can usually be stopped by wiggling or reseating connections

D. When pressing a printed circuit board tightly into its connections stops the intermittent problem, the board should be removed and the edge connectors cleaned with an alcohol-base spray or liquid cleaner

(CAUTION: Some technicians have used pencil erasers to clean edge connectors on printed circuit boards, but since these edges are gold plated, the eraser removes the plating and will shorten the life of the board — so do it right with a cleaner.)

E. When the intermittent problem is traced to a printed circuit board and the problem can be stopped by "flexing" the board, this usually means the board is cracked or a soldered joint has become bad

F. When "flexing" a board is the only way to get it to work, the board should be returned to a repair center, but information concerning what was done to get the board to work should be sent along to save more troubleshooting time

(NOTE: This is a good example of why it's beneficial to keep records of troubleshooting activities.)

INFORMATION SHEET

X. **Intermittent and other problems related to overheating**

  A. Intermittent problems associated with components such as IC's and capacitors may occur only after the system has run for a certain length of time, and this frequently indicates a problem with overheating

  B. Both IC's and capacitors have a tendency to fail when they are overheated, but may operate normally after they cool off

  C. Checking for an overheating problem requires using a spray circuit cooler (such as Zeromist) systematically:

    1. Allow system to warm up until failure occurs

    2. Start forward or back and spray cool one component at a time in order until normal operation is restored and the faulty component identified

    (**CAUTION:** Shield IC chips from spray mist because it will damage some of them.)

    3. Return the faulty board to a repair center with proper documentation of how the bad component was identified

  D. When a system is completely loaded with boards and an intermittent problem occurs only after periods of extended operation, the cause probably is poor ventilation and the solution will probably require installation of an appropriate fan

  E. Since cooling can be used to isolate a bad component, so can heating:

    1. Turn system on

    2. Use a heat gun or hair dryer to apply heat to one component at a time until failure occurs

    (**CAUTION:** Excessive heat can cause normally good power transistors to fail, but otherwise a hair dryer will normally produce no more heat than the system itself produces when operating.)

    3. Return the faulty board to a repair center with proper documentation of how the bad component was identified

XI. **Record keeping for module replacement**

  A. New modules used to replace bad modules should be recorded by name and serial number on whatever label is used to identify the module

  B. In addition to serial numbers, the routine or technique used to correct the problem should also be summarized and recorded on a card or sheet that is placed with other records in the computer "history" file

  (NOTE: These records will not only speed up troubleshooting should the problem occur again, but also serve as troubleshooting guidelines for similar problems in other systems.)

INFORMATION SHEET

XII. **Ways to determine if a module should be replaced**

A. Make a thorough check of the boards in the system

B. In the case of main boards, a good check is to run a diagnostic disk because a good diagnostic will usually point directly to the memory part that needs replacing

C. Check boards such as memory boards, communications boards, and video boards for special switches or blocks of small switches:

1. Make sure switch settings agree with manufacturer's recommendations

2. Move the switches back and forth several times to improve contact on switches that may have become oxidized or corroded in an environment subjected to corrosive vapors or smoke

D. Refer to notes from the initial customer conferences to determine if the problem occurred immediately after a change or addition to equipment

E. Check board switch settings for possible improper switch settings

Example: On IBM and IBM look-alike systems that were originally produced with a color board driving the video system, when a monochrome board is added and switch changes are made on the board, the monochrome board will bypass the color monitor and assume a control position, and will also bypass the printer if it is connected to the outlet port on the color card

F. When no conflicts in switch settings are found, chances are the problem is in the board itself

XIII. **Unloading the system**

A. Rule number one for unloading a system is: NEVER INSERT OR REMOVE A BOARD WITH THE POWER ON

B. Use a standard procedure to determine the need for module replacement:

1. If the microcomputer has a full or nearly full complement of boards

2. If the problem does not appear to be associated with all the boards

3. Then, the boards that are not suspect can be removed from the system to "unload" the power supply

4. Unloading will also allow the suspect boards to operate without interaction with boards that apparently are not causing the problem

INFORMATION SHEET

C. If removing the boards changes the characteristics of the problem, there is a possibility that:

  1. An improper interaction exists between two or more boards

  2. The power supply is being loaded excessively

D. To check for excessive power supply loading, monitor the voltage supplied to the suspect board(s) as the remaining boards are added or removed from the circuit

(NOTE: Here once again is an example of how a forward to back or back to forward technique can be successfully employed in a troubleshooting routine.)

XIV. **Hardware vs. software problems**

A. When all sections of related hardware are operating normally, and there is still a problem with the operating system, the problem may be in software

B. Whether disk or tape, magnetic media is easily subject to damage from heat, dust, smoke, or magnetic fields

C. The quickest way to solve an OS problem when software is suspect is to obtain and run a backup disk or tape

D. Sometimes the problem can be an interaction problem between hardware and software

E. Interaction problems usually occur when there is an underlying problem in either software or hardware and the problem may present itself in a variety of ways:

  1. Failure to print properly

  2. Improper or incomplete video display

  3. Disk drive failure

  4. Failure to store pages correctly

F. One of the tricky elements with an interaction failure is that software will work properly on one system and then fail to work on what appears to be an identical system

G. Best approach to an interaction problem is to interchange system parts until the problem is duplicated in the target system, and that will identify the point of failure

H. Interaction problems related to software simply require interchanging software to isolate the problem software

INFORMATION SHEET

XV. **How to handle media problems**

A. When all hardware is working perfectly and some feature of a program fails to work or works improperly, chances are it is a media problem

B. Media problems can occur with disks or tapes, and in some cases, ROM or an EPROM can create a problem similar to a media problem

C. When the media problem is with a disk, it is common practice to initialize the suspected disk a second time so the initialization procedure will pinpoint faulty sections on the disk

D. When a disk is found to be free of faulty sections, the original program can be copied from the backup onto the reinitialized disk

(NOTE: Here is another instance of the value of making a backup copy of all software.)

E. When the media problem is simply a bad tape, replace the tape

F. When the media problem is in a ROM cartridge that malfunctions as temperature increases or changes, the only solution is to replace the entire ROM cartridge

(NOTE: These programming ROM cartridges are found on smaller micros such as the Atari.)

XVI. **Keyboard problems and lockouts**

A. The disk or ROM diagnostics provided by the manufacturer will normally allow a check of the key functions for proper key closure (or activation of a switch) and, in some cases, if the key has a repeat function, the diagnostics will indicate whether or not it is working

B. When a key fails and a good keyboard is substituted, and the key will still not function, check for lockout functions because some keys can be locked out by certain functions in a program

XVII. **Troubleshooting monitor problems**

A. Always check for the possibility that a contrast or brightness control has been inadvertently turned out of adjustment

(NOTE: On most monitors these controls are external and easy to find, but on other monitors, a screwdriver may be required to reach inside the monitor case to make a check or adjustment.)

B. Never assume that the monitor is bad until it has been established that the proper signal is reaching the monitor, and the best way to do this is to substitute a known good monitor

INFORMATION SHEET

C. If no signal is present after monitor substitution, check the cable by substituting a good cable or by doing a continuity check from one end of the cable to the other

D. If there is still no signal after cable substitution, and there is a driver section or driver card in the computer, then check it to make sure the monitor is compatible with the system driver

E. If the micro drives a TV set as a monitor, there will probably be an RF adaptor and an attenuator between the computer and the TV set, and these should both be checked by substitution

F. When there is still a monitor problem after the signal, cable, and driver card have been checked, then the monitor itself should be checked

XVIII. **Steps in correcting monitor problems**

A. Once the monitor has been clearly identified as a monitor problem, run a monitor diagnostic disk and make adjustments as indicated by the diagnostic pattern that the program puts on the screen

B. When suggested adjustments with the diagnostic pattern do not solve the problem, then the monitor case has to be opened

C. UNPLUG THE UNIT AND ALLOW IT TO SIT FOR AT LEAST ONE HOUR BEFORE OPENING THE MONITOR CASE

(CAUTION: This is to allow the high voltage around the monitor to drain off, but the high voltage can be discharged following procedures outlined in Job Sheet #8.)

D. Once the unit is safe to enter, TAKE THE MONITOR COVER OFF WITH EXTREME CARE

(NOTE: Many systems with integrated monitors are designed more for compactness and style than service convenience, so it's very easy to break a CRT if you're not extremely careful, and breaking a CRT is not only expensive, but because the tubes implode upon breaking, flying glass can create an extremely dangerous hazard.)

E. Once the monitor case is opened and interior equipment exposed, inspect the monitor visually for burned or broken parts

INFORMATION SHEET

F. If there are modules inside the monitor, do a module replacement routine as previously outlined

G. If replacing modules does not correct the problem or there are no modules and no broken or burned parts, then the monitor should be returned to a repair center

(CAUTION: Do not attempt to make adjustments on the circuitry inside a CRT unless you are qualified and have the proper high-voltage equipment.)

XIX. **Monitors with screen RAM problems**

A. In some cases, the monitor may have a section of RAM that is dedicated to information to be presented on the video display

B. A good diagnostic disk should check screen RAM, but if there is doubt that the diagnostic has made the proper check, then make a substitution check of the chips in the memory section where screen RAM is located

XX. **Disk drive characteristics and problems**

A. Because disk drives are normally used more often than other peripherals, they are subject to more wear and are frequently the source of problems with microcomputer systems

B. Problems very common to disk drives of all makes include:

1. Dirty heads
2. Speed problems
3. Alignment problems

C. One of the first rules for troubleshooting disk drives is to make sure the problem is not a disk drive motor or stepper motor problem

D. When the problem with motors has been eliminated, a diagnostic disk should be run on the drive, but to assure that the diagnostic runs properly, the drive head should first be properly cleaned

E. Since cleaning the head on a drive involves partial disassembly of the drive, it is a good time to clean and lubricate the guide rails and clean dirty connectors

INFORMATION SHEET

XXI. Troubleshooting disk drive motors

A. Insert a disk and listen for the sound of the drive motor running, and also listen for the stepper motor that steps the head in and out of the various tracks on the disk

B. If the disk insert slot is not completely blocked by the door, shine a penlight flashlight into the drive to make sure the disk is turning

C. If any of these checks prove that the disk drive motor or the stepper motor that drives the head are not operating, then the drive must be removed and sent to a repair center

XXII. Steps in removing disk drives

A. On systems where the drive(s) is integrated, unplug the microcomputer at least one hour before working on the system or safely discharge high voltages

(NOTE: External drives simply require removal of the disk drive case.)

B. Remove the screws that hold the computer case to the frame, and be sure to keep the screws in order for reassembly

(CAUTION: When you run into screws that are sealed with sealant or paint, check the warranty for the possibility that opening the case could void the warranty.)

C. Lift the computer case carefully off the frame and beware of hitting the CRT or other components as you remove the case

D. Unplug the ribbon cable and the power supply line to the first drive

E. Check for a ground wire on the first drive and disconnect or loosen as required

F. Remove the screws that hold the first drive in its metal mounting brackets and put the screws aside in order for reassembly

G. If required, repeat the procedure for the second drive and place both drives aside for cleaning, lubricating, and reassembly

XXIII. Steps in cleaning and lubricating disk drives

A. After the disk drive has been properly removed and disconnected, remove the screws or holders from the logic board on top of the drive

B. Unplug the head connector before attempting to move the top logic board, and if it is a double-sided drive, there will be two head connectors, so be sure to keep track of where they go

INFORMATION SHEET

C. Turn the logic board over gently so that it folds out as far as possible and provides convenient access to the head and to the guide rails the head rides on

D. Open the drive door before attempting to clean the head

(NOTE: Leaving the door open on a double-headed drive will keep the heads apart, and the open door will keep single-headed drives away from the pad so cleaning can be accomplished easier.)

E. Saturate a cleaning swab with alcohol, start along the stripe in the middle of the head where the read/write area is located, and work out away from the center of the head as you clean

(NOTE: Make sure only the saturated cotton swab touches the head, but remember that the residue from the oxide coating can really stick to a head, so don't be afraid to rub hard enough to do a good job.)

F. While cleaning heads and pads, inspect them to make sure they're in good condition, and if pads need to be replaced, do it at this time, or make a note of it so the pads can be replaced if the drive should be sent to a service center

G. Saturate another cleaning swab with alcohol and clean both of the guide rails

H. Lightly dampen another cleaning swab with a lubricant that does not have a silicon base and lubricate the guide rails lightly

I. Reconnect the head connectors to the drive's top logic board, or if it is a double-sided drive, reconnect both head connectors exactly where they were removed

J. Put the logic board back on top of the drive frame and put screws in finger tight

K. Connect the power supply to the drive and make sure it is firmly seated

L. Check the edge connector on the ribbon cable connection, and if the edge connector appears tarnished, clean it with alcohol and a cleaning swab before reconnecting it

M. Place the drive back in its mounting brackets, but don't tighten screws firmly yet

N. Plug the computer in and turn it on, and if the light comes on and the drive steps back to track zero, the cleaning is complete

O. All screws in the top logic board can be tightened, the drive or drives can be replaced in their brackets and secured, and the drive is ready to run a diagnostic disk

INFORMATION SHEET

XXIV. **Troubleshooting disk drive speed problems**

A. After checking the disk drive motor and the stepper motor, run a diagnostic disk first to get a video display of specific problems with the drive:

1. Incorrect drive speed
2. Failure to go to zero track
3. Failure to step the head

B. If the diagnostics indicate a drive speed problem, it can be verified by using a speed-check disk which will indicate on the video display whether the speed is too fast or too slow

(NOTE: Verbatim and Dysan both manufacture speed-check disks for this kind of testing.)

C. When the problem has been clearly identified as a drive speed problem, chances are the speed can be adjusted and the drive will not have to be sent away for repair

XXV. **Steps in adjusting disk drive speed**

A. Turn the computer off and read the manufacturer's instructions for this procedure if they are available

B. Remove the computer case, if the system is integrated, and save all screws for proper reassembly

C. With the disk drive exposed, remove the screws that hold the drive in its frame

(NOTE: Many disk drives have only two screws in the side of the frame, but others have more, and in both cases the screws should be carefully set aside for reassembly.)

D. Remove the ribbon cable connector that provides control signals and unplug the four-wire power connection

E. Place the drive on a clear, clean work area so that the ribbon cable and power supply cable can be reattached so the drive can be safely operated again

F. If the ribbon cable or the power supply cable are not long enough to permit convenient operation of the drive, use "extender cables" as required

G. Make sure a fluorescent light is available at the work area to check the strobe pattern on the disk drive flywheel

INFORMATION SHEET

H. Turn the computer on and put the drive into continuous operation while exposing the flywheel to the fluorescent light

I. Determine from the strobe pattern on the flywheel that adjustment is required

J. Double check with manufacturer's recommendations, and make the required adjustment by turning the adjustment potentiometer right or left

(NOTE: Depending on the type of drive, the adjustment potentiometer may be accessible from the top, the back, or through a hole in the side of the drive frame, and double check to make sure it is the correct potentiometer.)

K. Adjust the potentiometer so that the strobe pattern on the flywheel seems to stand still at 60 cycles per second

(NOTE: There is an inside band on the flywheel with a 50 marked on it to indicate 50 cycles per second which is the required adjustment for power supplies in Europe.)

L. Check the belt on the large pulley by grabbing it on the underside of the pulley and holding it with your fingers:

1. If this causes the motor to stall, the belt is okay
2. If the belt stays in place and the motor still runs, the belt is worn and should be replaced

M. Turn the computer off

N. Check the ribbon cable connection to the drive and if it looks tarnished, clean it with alcohol on a cotton swab

O. Secure disk drive in its frame, replace drive and cables, and replace and secure the computer case

P. Turn computer on again and run the diagnostics to double check for proper disk drive speed

XXVI. **Troubleshooting disk drive controller problems**

A. When all checks have been made and disk drive(s) continues to have errors, the problem may be with the disk controller

B. The first check on a controller should be to clean the contacts on the controller card and then reseat the card

C. The next step should be a check of all cable connections for proper seating

INFORMATION SHEET

D. Cable continuity should also be checked by taking the cable(s) loose at both ends and using an ohmmeter to check from the pin on one connector to the corresponding pin on the other connector

E. Certain diagnostic disks will check certain features of the disk controller, but the diagnostic must be checked carefully to determine what features of the disk controller card it can check

F. Finally, a bad controller can be identified by swapping it out with a known good controller

XVII. **Printer problems**

A. Next to disk drives, printers are subjected to more mechanical wear than other parts of a microcomputer system, and a printer failure is far more likely to be mechanical or electromechanical than electronic

B. The first step in troubleshooting a malfunctioning printer is to determine if the trouble is a mechanical problem or an electronic problem involving the logic components of the printer

XXVIII. **Basic printer troubleshooting routine**

A. When a printer will still operate, follow directions from the user's manual and set up the required operating sequence for the printer to perform a self-diagnostic program

B. Once the printer is operating, observe the printer in action and evaluate the pattern it makes according to information from the user's manual

C. When it appears that the printer is physically sound enough to properly run the complete diagnostics, the trouble is probably in the driver card or the connecting cable

D. The best way to check both driver card and connecting cable is to substitute known good parts and test the printer again

E. Watch for microcomputers that have multiple jacks at the back of the machine because some of these jacks are for parallel printers and some for serial printers, and there may be other jacks similar in appearance that are not for printers at all

F. When there are multiple jacks at the back of the microcomputer, check the user's manual for the correct connections, and never assume that the customer has the cable in the proper jack

(NOTE: Printer cables normally use DB-25 jacks, but these jacks are also used for other applications, so if it all seems confusing, remember to do the customer a favor — check and label all jacks that are not labeled.)

INFORMATION SHEET

XXIX. **Common printer mechanical problems and their solutions**

A. Paper feed problems

1. A common printer problem, but more so with printers that have both friction and pin feed capabilities

2. Best solution is to check user's manual for cleaning and adjustment procedures

3. When friction feed parts are broken or missing, printer should be returned to a repair center

B. Ribbon problems

1. Many printers have specialized ribbon containers that look like commercial typewriter ribbon containers, and some people use regular commercial ribbons in order to save money

2. Some ribbons are also lightly oiled so the print head will be lubricated as it is used, and improper ribbon selection will lead to early print head failure

3. Subtle differences between a commercial typewriter ribbon and a printer ribbon could cause the ribbon to wind around the ribbon feed instead of around the take-up spool, and the printer may run several hours before the problem becomes apparent

4. Best solution to all ribbon problems is to remove the improper ribbon, put the right ribbon in the printer, and encourage the customer to use only printer ribbons recommended for the printer

5. Always determine if the customer has been using a cotton ribbon because this will require extra attention in cleaning the print head and the printer in general

C. Print head problems

1. A print head that wears out is a common problem on dot matrix printers, and the problem will usually evidence itself early by loss of parts of the matrix so that part of a character no longer appears on the printed image

2. The solution for a worn print head is to install a new one which is usually as simple as snapping the old head out, removing the electrical connecting cable from its socket, and then snapping the new connector cable and print head into place

INFORMATION SHEET

XXX. **Steps in troubleshooting a computer that will not drive a good printer**

A. If the printer has no mechanical problems, and if the diagnostics run but the computer will still not drive the printer, substitute a known good cable first, and then substitute a known good printer

B. If the signal from the computer is capable of driving a known good printer, then the problem printer should be returned to a service center for repair

C. If the signal from the computer will not drive a known good printer, and the cable has been verified as a good cable, and the cable is in the right jack, then the trouble is probably in the printer interface card

D. When the printer driver is part of a multifunction card, it is sometimes possible to insert an ordinary printer drive card and run the printer from a separate driver

E. When changing out a multifunction driver for an ordinary driver card, always check manuals carefully because such a change also requires changing switch settings on the printer board, the main board, and the multifunction board

F. When changing out printer driver cards, also beware of software switching commands that may be used to cue a particular card slot because the software will have to be changed to reflect the printer signal/card slot relationships

(NOTE: This could create a problem with an Apple or with IBM and IBM look-alike systems that have both hardware and software switches for printer signal control.)

XXXI. **Other areas of software/printer problems**

A. Some sophisticated software such as word processors, spread sheets, and data bases, require that the software be installed for a specific printer

B. When software is "installed" in this manner, it means that the conditions are set up in the software to mate with the data speed, handshaking, and other protocol required for a specific printer

C. When a customer complains that the printer works fine on everything but "new software," the customer should be told of the requirement for software "installation" which is a matter of running a set procedure in software and storing it back in the program

INFORMATION SHEET

XXXII. Printer handshakes

A. Occasionally, the printer driver card or the printer driver section of the computer has been set to originate and react to what are known as "handshake signals" that are sent to and from the printer

B. Handshakes are easily accomplished on two or three electrical lines so that electrical signals can:

1. Announce to the printer that a character is being sent

2. Reply to the computer that a character has been received and that the computer can send another character

C. The most common signal arrangement is called the "Centronics Standard," so when you hear or read a reference to that standard it is a reference to the electrical signal exchange between the computer and printer as to when information is exchanged back and forth between the two

TROUBLESHOOTING
UNIT X

JOB SHEET #1 — CHECK VOLTAGE ON A MICROCOMPUTER POWER SUPPLY

A. Tools and materials

1. Microcomputer as selected by instructor
2. Screwdrivers
3. Nutdrivers
4. DVOM
5. User's manual or service manual
6. Pencil and paper and troubleshooting log

B. Procedure

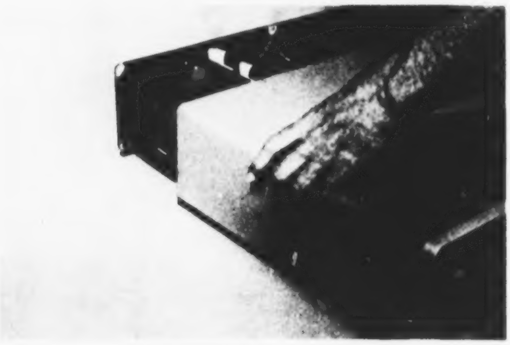
1. Make sure all troubleshooting steps required to this point have been completed
2. Find the section in the service manual that details the disassembly procedure for the computer and read it carefully

   (NOTE: Sign on the troubleshooting log that accompanies this job sheet and save it for use with the job sheets that follow.)

3. Disassemble the computer, being careful to remove the case carefully and to damage no other parts of the system (Figure 1)

   (**CAUTION:** Make sure the computer has been unplugged long enough for the high voltage to bleed off, but if there is an integrated CRT with the system, the high voltage can be discharged quickly with the procedure outlined in Job Sheet #8.)

   FIGURE 1



JOB SHEET #1

4. Save all screws

   (NOTE: Many technicians place the screws in a container of some kind, and some technicians place the screws in order as they're removed so there is no question about replacement order.)

5. Consult your service manual for exact location of the power supply

   (CAUTION: The high voltage for the video display will also be in the case if the unit has a self-contained video display unit, so do not confuse the two because if you place your meter connection on the output of the video display unit power supply, you may destroy the meter.)

6. Remove any other metal or plastic shielding parts to permit full access to the power supply

7. Turn to the schematic section of the manual to find the voltages and identify the test points in the power supply for measuring the voltage on the power supply (Figure 2)

   (NOTE: Most power supplies have several voltages; the most common are a +5V and +12V, and they may also have -5V and/or -12V. If there are special purpose devices such as EPROM's, there could be other voltages.)

   FIGURE 2

8. Identify voltages and test point locations. Double check to make sure the power is off

JOB SHEET #1

9. Connect the meter leads as follows:

    a. The common or negative lead should go to the location identified as either common or ground for the power supply

    b. The active voltage measuring lead, usually called the positive lead, should be connected to the first voltage test point

    (**CAUTION:** Remember that if this is a switching power supply, it typically cannot be disconnected to make volt measurements.)

10. Make connections properly and set meter for the proper voltage measurement scale

    (**CAUTION:** Be sure you're on the voltage measurement scale and not the current measuring scale or the ohmmeter because either one of these scales could be damaged if connected to voltage.)

11. Turn the power on the computer system

12. Wait for the meter to settle

13. Take the reading after the meter has settled, turn the power off, and record the reading or make a mental note that it is correct or not correct

14. Move the meter connection to the next point to be measured, as long as the polarity remains the same

    (NOTE: If the polarity changes from positive to negative, for example, and the meter does not automatically change polarity, you must then change the function of the test lead; take the lead to the common or ground and then use the common or ground lead to do the measuring; typically these leads are black and red, black for common and red for measuring.)

15. Repeat this procedure for each of the voltages available from the power supply, and all voltages should be noted or recorded before proceeding

    (NOTE: If one or more voltages is incorrect, check for fuses or any other obvious means of disconnect such as a circuit breaker.)

16. If this fails to restore the voltage, remove and replace the power supply module

17. Check all voltage measurements after replacement

    (**CAUTION:** NEVER assume that a new module will solve the problem. Measure voltages for the correct values.)

18. Check with your instructor for next troubleshooting procedures or directions

19. Turn off all test instruments and return tools and equipment to proper storage areas

JOB SHEET #1

Troubleshooting and Repair Log

Customer's Name ______________________ Invoice ______________

Date ______________ Equipment and Serial # ____________________

Complaint ____

____

Technician's Name & ID #	Date	Time On	Time Off	Work Performed	Replacement Parts Used & Inventory #

TROUBLESHOOTING
UNIT X

JOB SHEET #2 — TROUBLESHOOT A MICROCOMPUTER THAT WILL NOT BOOT UP

A. Tools and materials

1. Computer that will not boot up
2. Technician tool kit
3. DVOM or VOM
4. Pencil and paper and troubleshooting log
5. Available service manuals and user manual

B. Procedure

1. Power down computer one hour in advance if the video display system is integrated with the computer

   Example: The TRS-80 III has an integrated video display system and should be powered down an hour before working inside the micrcomputer, or the procedure outlined in Job Sheet #8 can be used with proper supervision

2. Remove cover according to safe procedure

   (NOTE: Be sure to sign on the troubleshooting log that accompanied Job Sheet #1.)

3. Complete sensory inspection
4. Check to see if micro will initialize
   a. Initialization in most micros will occur previous to the booting of the DOS
   b. If you turn the machine on and after a short warmup period the cursor appears on your screen, the machine has initialized because it will not produce the cursor until it has initialized
   c. Initialization routine may also turn on the disk drive, and yet the disk drive may not boot the DOS
   d. This will probably be evidenced by the whirring of the drive and the head loading light coming on
   e. Some machines will initialize without giving any external evidence such as a cursor or disk load light without external sensory evidence such as whirring of disk, appearance of cursor, or presence of a disk load light

JOB SHEET #2

5. Check for external evidence of initialization such as cursor disk light, and then continue:
    a. Check supply voltages to the main board and to the disk drive and disk controller board
    b. If the only evidence of initialization is the cursor on the video display, it is important to check to make sure the video display is properly connected, on, and properly adjusted
    c. In most cases the adjustments of brightness and contrast can be adjusted high enough to show the raster on the video screen
    d. The raster is a picture that you see on a video or tv when no picture is present and all that are present are the horizontal scan lines across the face of the tube lighted, but it will take careful examination to see the lines
    e. If you get the raster on video display, but no cursor, it is an indication that the system did not initialize
6. Confirm that system will not initialize
    a. If the system has not initialized and you have checked the proper voltages and there appears to be no visual damage, then turn the power off
    b. Unplug the system
7. Change out the system main board with a known good board (Figure 1)

FIGURE 1

8. Check for a proper cursor signal, and if the new main board will not cause the system to initialize and power is present and all other checks have been made, then the entire unit should be sent to a repair center

JOB SHEET #2

9. Check for proper cursor signal, and if the system will initialize but still will not boot up, or if the disk load light comes on and goes off, and the DOS will not boot up
   a. Try a known good alternate DOS disk (Figure 2)

      FIGURE 2

   b. As an alternate use the disk from the system on another good system
   c. This will allow you to determine if the DOS is causing the problem
10. Determine by substitution that the software is okay; then make sure that the disk controller card is properly seated because it may need to be pulled out, cleaned, and reseated
11. Check the ribbon cable from the controller card to the disk drive to see if it is properly connected, and if a substitution ribbon cable from the controller card to disk drive is not available, you may wish to do a pin for pin check with an ohmmeter
12. Substitute the cable into a known good computer to check it out if a same-make computer is available
13. Confirm that card and cable are in good working order, and if supply voltages are present at the disk drive, then the disk drive itself should be changed out with a known good disk drive
14. Confirm that disk controller cable and drive are shown by substitution to be operating correctly. Then the boot up failure will most probably be on the main board. The board should be changed out.

    (NOTE: Boot control may reside in ROM, and unless the service person is allowed to swap chips, the board should be changed out.)
15. Sign off your troubleshooting log

    ☐ Have your instructor check your work
16. Return all tools and equipment to proper storage area or prepare for next job sheet as directed by your instructor

TROUBLESHOOTING
UNIT X

JOB SHEET #3 — CHECK AND REPLACE FAULTY MODULES IN A MICROCOMPUTER SYSTEM

A. Tools and materials

1. Computer with modular printed circuit boards
2. Basic tool kit
3. Pencil and paper and troubleshooting log

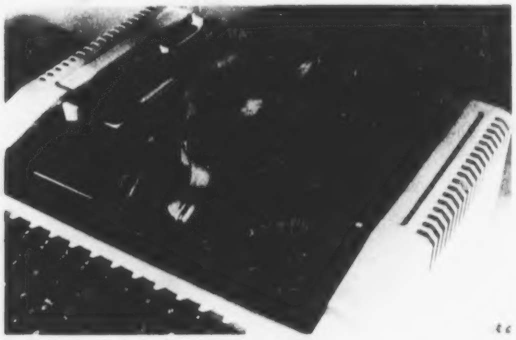
B. Procedure

1. Power down computer one hour in advance, or use the procedure outlined in Job Sheet #8 with proper supervision
2. Remove cover according to safe procedure

   (NOTE: Sign on the troubleshooting log from Job Sheet #1.)
3. Complete sensory inspection for:
   a. Loose parts
   b. Broken parts
   c. Signs of overheating
4. Pull board and reseat it (Figure 1)

   (CAUTION: Never remove or insert a board with the power on.)

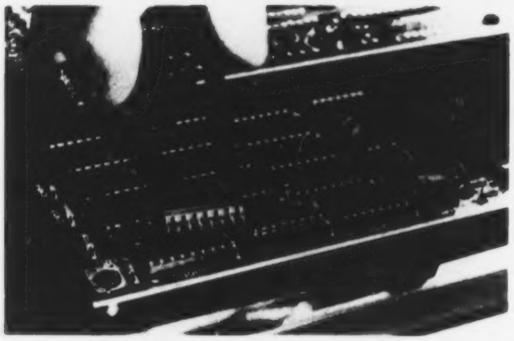
FIGURE 1



JOB SHEET #3

5. Power the machine up and run the disk diagnostic software
    a. If the board contains memory, the diagnostics will indicate any memories that need to be pulled and replaced
    b. Sometimes removing and reseating memory chips is all that will be required (Figure 2)

FIGURE 2



6. Allow diagnostics to run so potential problems with the disk drive can be identified

(CAUTION: If the diagnostics indicate a disk drive problem, unless you've had proper training, do not attempt to correct problems on the drive that require adjustment other than speed.)

7. Replace ROM chips in the same way as RAM chips if diagnostics indicate a ROM problem

(NOTE: In replacing ROM chips you have to be certain that the parts numbers match because the programs are different for ROM functions just as the programs required for other pieces of equipment.)

8. Make sure the problem goes beyond a clearly indicated RAM or ROM problem and is not reparable by replacing RAM or ROM chips, and the board should be changed out and the bad board sent to a repair office

(NOTE: Be sure to record the model number and serial number of the new board installed and the date it was installed.)

JOB SHEET #3

9. Check for correct switch settings (Figure 3)

FIGURE 3

a. Certain types of printed circuit boards such as the modules that contain memory or drive video displays have blocks of switches which need to be set correctly for various applications of printed circuit board modules in combination functions

b. During the customer conference, be sure to find out if any new features have been added to the computer

10. Move switches on or off a time or two to ensure that they're making good contact, and also make sure switches are set correctly

(NOTE: Switches may have corroded due to improper environment, and if the customer smokes around the computer system, there's a good chance of switch problems.)

(CAUTION: The switch settings on the main board may be set for monochrome and if you use a color card instead, you could do damage to the card or to the video display, so do not experiment with changing switch settings.)

11. Unload the system if other checks do not isolate the problem

a. The system may be overloaded by using too many available card slots because the fact that a certain number of card slots may be available is no indication that they can all be filled

b. One of the things that has happened to computer cards in recent years is that the cards now contain multi-function capabilities instead of, perhaps, function in a slot

c. Installing four or more functions in a slot where power is provided for only one function can easily overload the system

JOB SHEET #3

d. Filling up the card slots with multi-function boards that generate more heat and restrict air flow may cause the machine to heat up enough internally to cause thermal overload

(NOTE: Double cards, cards with multi-functions literally sandwiched one on top of the other, are especially bad about this because they not only build up more heat, they eliminate the ventilation space between the cards.)

e. Add an additional fan to the system to solve thermal overload

(NOTE: Apple is noted for ventilation problems when filled up with cards, and several companies produce "add on" fans especially for the Apple.)

12. Check to see if unloading the system causes enough change in the power supply to cause the system to operate correctly

13. Check with customer or service manager for options to correct the problem:

    a. Reduce the number of cards

    b. Install a larger-output power supply

14. Complete reduction of cards or installation of new power supply

15. Power machine up and run diagnostics again

16. Replace computer cover and make sure all screws removed are firmly secured

17. Sign off your troubleshooting log

    ☐ Have your instructor check your work

18. Return tools and equipment to proper storage area or prepare for next job sheet as directed by your instructor

TROUBLESHOOTING
UNIT X

JOB SHEET #4 — TROUBLESHOOT A MALFUNCTIONING FLOPPY DISK DRIVE

A. Tools and materials

1. Malfunctioning floppy disk drive
2. Basic tools kit
3. Diagnostic software
4. Fluorescent light
5. Lint-free cleaning swabs and alcohol-based cleaning fluid
6. Paper and pencil and troubleshooting log

B. Procedure

1. Complete troubleshooting preliminaries such as checking the disk controller to make sure the problem is definitely with the disk drive

   (NOTE: Sign on your troubleshooting log.)

2. Determine the amount of degradation. Find out if it works at all. If it works well enough to operate a disk, insert the diagnostic disk.
3. Attempt to operate the disk diagnostic procedure (Figure 1)

FIGURE 1

JOB SHEET #4

4. Determine if the symptoms are the inability to read certain disks or problems with reading and writing. You may have a simple problem that can be readily fixed by

   a. Cleaning the head of the disk drive

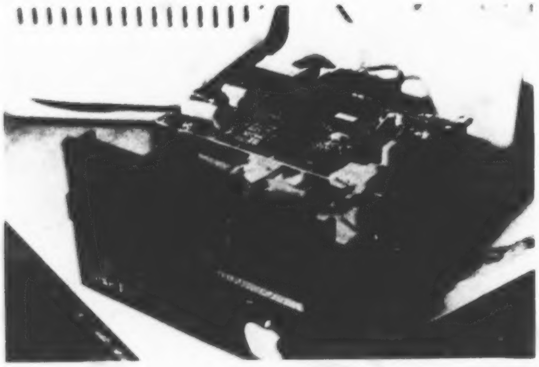
   b. Adjusting speed of the drive motor

   (NOTE: There are two motors, one that drives the spindle that the disk rotates on, and one that runs the head back and forth which is called a "stepper" motor.)

5. Clean the head with the following procedure:

   a. First disassemble the computer, unless these are external drives, in which case, simply remove the cover from the disk drive (Figure 2)

   FIGURE 2



   b. Remove the screws that hold the disk drive in place; typically there are between three and four screws, usually found in the side of the disk drive case

   (NOTE: There are a few disk drives with special mountings to facilitate portability; so in that case, read manufacturer's disassembly instructions.)

   c. Once the drive is removed, turn it to allow access to the drive head or heads

   d. In the case of a single head drive (single sided disk drive), there is a pad that makes contact with the disk opposite the head, lifting the head by opening the disk drive door or lever will lift the head away from the pad or vice-versa

JOB SHEET #4

e. Take the cotton swab and head cleaning fluid and dip the swab in cleaning fluid, squeeze swab to remove most of the alcohol (against side of container)

(NOTE: In some cases the heads cannot be accessed unless you remove the printed circuit board on top of the drive, in which case, screws or snaps which hold the printed circuit board should be removed.)

(CAUTION: Do not disconnect the electrical edge board connectors because they are similar in length and shape and you might inadvertently get them back in the wrong places and the board can be set aside without disconnecting these connectors.)

f. Keep the pad off of the head, and with the alcohol-soaked swab clean the head, starting from the center of the head and work your way out

(NOTE: The oxide will be obvious if a brown or reddish-brown color shows on the swab, and it may require a fair amount of scrubbing to remove the oxide from the head.)

(CAUTION: Do not use anything harder than the swab to clean the head.)

g. If that swab gets dirty, use another clean swab until you have removed all the oxide and this may take awhile

h. Once the head has been cleaned, then make sure that all of the parts of the swab (residue, fibers, etc) leave no cleaning residue in the drive

i. Take a clean swab soaked with alcohol and clean the pad; it will also have oxide material on it, and leave the heads and pad apart so that the pad can dry

j. Replace pad if pad is damaged

k. On the double-sided drives there are two heads opposing one another that run on either side of the disk. Keep the heads apart by opening the disk drive door or lever; turn the drive so you can clean one head completely from the center out

l. Turn drive so you can reach the other head and clean it from the inside out

m. Keep heads apart until they are dry (there are no pads to worry about on a double-sided drive)

n. Once the heads are clean, replace the printed circuit board if it has been removed

JOB SHEET #4

6. Check the drive speed with the following procedures:

   a. Reconnect the power cable and control cable

      (CAUTION: Make sure the control cable goes on correctly, not upside down because some of them can be put on upside down.)

   b. It may take a little ingenuity to work the drive into a position where you can see the flywheel strobe markings

   c. Place the system where the drive is to be checked under a fluorescent light or lamp over the drive where the drive is being run

   d. Use the line frequency flicker from the 60 hertz power line as the strobbing frequency

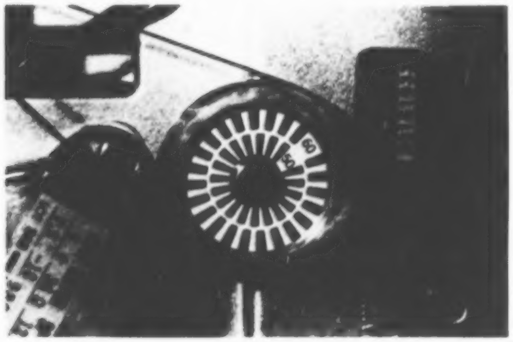
   e. Some disk drives operate the spindle motors at all times and on the drives the spindle motors operate only when the system software runs

   f. If the system requires software to operate, then you'll have to place an exercise disk or some sort of software driver in the system to actuate the drive

   g. When the drive is operated (spindle motor running), the strobe bars and the flywheel will appear to stop when the speed is correct (Figure 3)

      (NOTE: Most disk strobes contain markings for 50 and 60 hertz and in the U.S., the speed is 60 hertz, in Europe 50 hertz, so use the appropriate strobe.)

      FIGURE 3



   h. There is a potentiometer on the edge of the printed circuit board that can be identified by looking at the technical literature

   i. Adjust the potentiometer until the strobe stops at the proper frequency; it will appear to stop and be stationary when correctly adjusted

JOB SHEET #4

7. Run diagnostics

   (NOTE: It should be possible to do this with the disk drive partially disassembled, but make sure all electrical wiring is in a safe position, and if diagnostics require reassembly, then put the drive back together.)

8. Evaluate diagnostics, and if neither of these procedures have solved the problem, substitute another known good disk drive and run the diagnostics

9. Evaluate diagnostics, and if the diagnostics still fail, then you may have to refer back to the testing of the disk control board, cabling, or even the main board

   (NOTE: It is likely that the substitution of a new disk will solve the problem.)

10. Make all evaluations or changes for which you are qualified, but if there are troubles such as tracing problems, stepper head problem, or electrical problems on the disk drive printed circuit board, the drive will have to be sent to a repair center

11. Sign off your troubleshooting log

    ☐ Have your instructor check your work and discuss your troubleshooting procedure and findings with your instructor

12. Return all tools and equipment to proper storage areas or prepare for next job sheet as directed by your instructor

TROUBLESHOOTING
UNIT X

JOB SHEET #5 — TROUBLESHOOT A MICROCOMPUTER KEYBOARD

A. Tools and materials

1. Microcomputer with malfunctioning keyboard
2. Basic tool kit
3. Diagnostic software
4. Lint-free cleaning swabs and cleaning fluid
5. Technical literature as available
6. Paper and pencil and troubleshooting log

B. Procedure

1. Complete troubleshooting preliminaries to make sure the problem is definitely with the keyboard

   (NOTE: Sign on your troubleshooting log.)

2. Determine type of keyboard:
   a. On some keyboards, the keys are units unto themselves and can be desoldered from the keyboard and replaced
   b. On other keyboards, the entire assembly is one piece and a single key cannot be replaced unless the entire keyboard is replaced
3. Read the technical literature for running keyboard diagnostics
4. Run diagnostics and look for the following:
   a. Rows or columns of key switches that seem to be malfunctioning (will be identified in technical literature)
   b. Trouble in the connecting link or wire that leads to the malfunctioning row or column of keys
5. Repair only those problems you're qualified to handle, but in the absence of special training, the keyboard should be changed out and the old keyboard sent to a repair center

JOB SHEET #5

6. Determine if the keyboard is a complete malfunction, and if it is:
   - a. Check for a logic board in the system that drives the keyboard
   - b. Change out the logic board with a known good board, and check keyboard for proper operation

7. Use the BASIC alternate if a keyboard diagnostic program is not available:
   - a. Place the program in basic and evaluate the video display as each key is pressed
   - b. Check all alphanumeric keys and all special purpose keys for proper operation
   - c. Check the tables in the user's manual for alternate keystroke characters and check all alternate characters
   - d. Beware of any special function key or lockout key that may confuse the test

8. Test the keyboard cable and connectors with the following procedure:
   - a. Substitute a known good cable for the old one
   - b. If a substitute cable is not available, separate both ends of the cable from the system and check cable continuity with an ohmmeter
   - c. If the connectors are suspect, clean them with alcohol on a lint-free swab, then check the keyboard again

9. Sign off your troubleshooting log

   ☐ Have your instructor check your work and discuss your troubleshooting routine and findings with your instructor

10. Return tools and equipment to proper storage areas or prepare for next job sheet as directed by your instructor

TROUBLESHOOTING
UNIT X

JOB SHEET #6 — TROUBLESHOOT A MALFUNCTIONING MICROCOMPUTER MONITOR

A. Tools and materials

1. Malfunctioning microcomputer monitor
2. Basic tool kit
3. VOM
4. Pencil and paper and troubleshooting log
5. Diagnostic software

B. Procedure

1. Complete troubleshooting preliminaries as required to make sure the problem is definitely with the monitor or isolated in the video display elements of the microcomputer

   (NOTE: Sign on your troubleshooting log.)

2. Check brightness, contrast, and other external controls to make sure they are all properly adjusted

   (NOTE: These controls are normally external, but some are internal and require adjustment with a screwdriver, but be sure this check is made first because it is not an uncommon problem with monitors and can save a great deal of time.)

3. Identify type of video display unit:

   a. TV set

   b. Monochrome display

   c. RGB

4. Check driver card or video drive system to make sure it is properly mated with the video display and the cable

   (NOTE: In most cases, cables designed for RGB's or RF TV's will not connect to cards designed for any other type display.)

5. Determine that the video display unit is actually the source of the problem by substituting a known good video unit, then checking to see if the system will drive it properly

JOB SHEET #6

6. Check cabling, any special adapters, and driver card if system fails to properly drive a known good substitute monitor

7. Establish for certain that the trouble is isolated in the video display unit, then unplug the computer and allow it to sit for a minimum of one hour so that all high voltage in the system will bleed off (Job Sheet #8 outlines an alternate procedure.)

8. Read manufacturer's procedure for disassembly and follow it carefully:

   a. If the unit contains a CRT, be very careful not to damage the tube (Figure 1)

   FIGURE 1

   b. Do not attempt to adjust anything around the CRT

   c. Once the case is open, make a visual inspection of the entire unit to look for burned or broken parts or especially for fuses that may have blown

   d. Make sure any fuses replaced are the correct fuses

9. Evaluate condition of video display, and:

   a. If visual inspection reveals no damage

   b. If there is no driver module or high voltage card supply module that can be replaced

   c. Change out the video display and ship it to a repair center

10. Use alternate routine to save time while high voltage is bleeding down:

    a. Many video display units have power supply cards that can be removed and replaced

    b. Rather than waiting an hour for the high voltage in a system to bleed down, go ahead and replace the power supply card with a known good card

JOB SHEET #6

11. Evaluate video display after board substitution, and if problem is not corrected, change out video display and ship it to a repair center

12. Determine if the monitor derives its low voltage from the low voltage power supply in the computer:

    a. Disable the high voltage section by disconnecting or removing it before making any low voltage checks

    b. If high voltage cannot be disabled, make no voltage checks at all

    c. If high voltage can be disabled, check the cable entry point to see if low voltages are present

    d. In all cases, do not attempt to measure voltages or do any sort of troubleshooting around the high voltage power supply section in the video display unit

13. Complete all possible checks and reassemble video display

14. Sign off your troubleshooting log

    ☐ Have your instructor check your work and discuss your troubleshooting routines and findings with your instructor

15. Return tools and equipment to proper storage areas or prepare for next job sheet as directed by your instructor

TROUBLESHOOTING
UNIT X

JOB SHEET #7 — TROUBLESHOOT A MALFUNCTIONING PRINTER

A. Tools and materials

1. Malfunctioning printer
2. Basic tool kit
3. User and service manuals
4. Pencil and paper and troubleshooting log
5. Diagnostic software

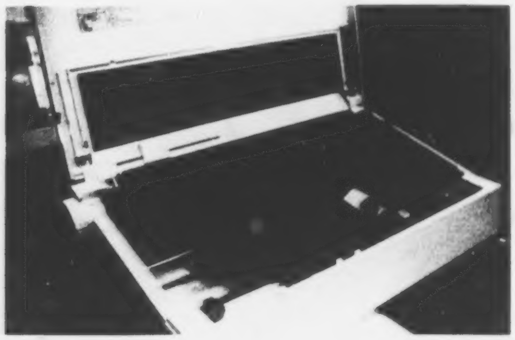
B. Procedure

1. Complete troubleshooting preliminaries required to make sure the trouble is with the printer

   (NOTE: Sign on your troubleshooting log.)

2. Check for loose parts and loose connectors before starting any other troubleshooting because printers are subject to a great deal of vibration, and loose parts and connectors are common printer problems (Figure 1)

   FIGURE 1



3. Substitute a known good printer to make sure the problem is definitely isolated in the printer

JOB SHEET #7

4. Read instructions for running the printer diagnostics

5. Load the printer with paper and run diagnostics:

    a. Compare the output with expected output as shown in the instructions

    b. If the self-diagnostics run but the printer does not function with the computer, then there is a communications problem between the computer and the printer

6. Compare the switch settings in the substitute printer with switch settings in the malfunctioning printer

    a. If switch settings are the same, the likely problem area is the communications board that connects the printer mechanism via the cable to the computer

    b. Self-diagnostics may not check the communications board so it should be changed out with a known good board and the diagnostics should be run again

    c. If the communications circuitry is part of the main board, then the main board must be changed out and the diagnostics run again

7. Complete communications circuitry checks and if printer still does not operate, it should be sent to a repair center

8. Read service manual for cleaning and lubrication procedures that may need to be accomplished at this time:

    a. When printer problems are the product of mechanical parts hanging up, cleaning and lubrication can sometimes solve the problem

    b. Clean as directed and lubricate with only recommended lubricants

9. Check for ribbons, type fonts, daisy wheels, or other routine items that evidence wear and need replacement

10. Check for add-on devices that may have been added to the printer by the customer

    a. It is a good idea to remove add-on devices and check printer operation

    b. Pin feeders and sheet feeders are sometimes add-ons, and both can jam printer operation under certain conditions

    c. Faulty sheet feeders can really be a headache, and unless you're trained on their operation and adjustment, be smart and send them back to the repair center

JOB SHEET #7

11. Check for faulty print head and replace according to service manual
    a. Changing out a print head is usually a simple task that requires unsnapping the print head and putting a new one in
    b. Change the print head in the field when it can be done
12. Sign off your troubleshooting log

    ☐ Have your instructor check your work and discuss your troubleshooting routines and findings with your instructor
13. Return tools and equipment to proper storage area

TROUBLESHOOTING
UNIT X

JOB SHEET #8 — DISCHARGE HIGH VOLTAGE FROM A CRT

A. Tools and equipment

1. Monitor as selected by instructor
2. OEM schematic or Computerfacts™
3. Hand tools and a clip lead
4. DVOM
5. Dual-trace oscilloscope
6. High voltage probe
7. Troubleshooting log

B. Procedure

(**CAUTION:** This procedure should be executed only in the presence of your instructor, and no future attempt to discharge high voltage from a CRT should be made without your instructor's permission and supervision.)

1. Sign on your troubleshooting log
2. Make sure the monitor is unplugged from the host computer and from its power source
3. Follow the OEM instructions for removing the screws from the monitor case
4. Check once again to make sure everything is unplugged
5. Discharge the CRT high voltage with the following procedure, and work with caution:
    a. Select a screwdriver that has a well insulated handle, and a clip lead
    b. Clip one end of the clip lead to the metal chassis of the monitor
    c. Clip the other end of the clip lead to the metal shaft on the screwdriver
    d. Locate the spot where the high voltage lead makes contact with the anode of the CRT

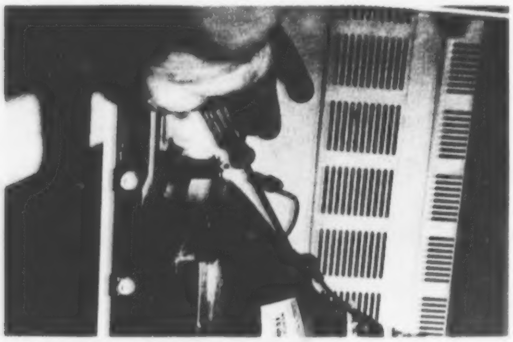
    (NOTE: Ask your instructor for help if you need it, but this point should be easy to find because the high voltage lead is usually larger than any other wires, and it usually has an insulated cover.)

JOB SHEET #8

e. BRACE YOURSELF FOR A LOUD POPPING SOUND, and, if the contact point of the high voltage lead and the anode is uninsulated, THERE WILL ALSO BE A BRIGHT ARC

f. Make sure you are holding the insulated handle of the screwdriver, then slip the blade of the screwdriver under the insulated cover so that it makes contact with the high voltage lead/anode connection (Figure 1)

FIGURE 1



g. Remove the screwdriver blade as soon as the loud popping sound ends

h. Sign off your troubleshooting log

☐ Have your instructor check your work

i. Clean up area and return tools and equipment to proper storage

(NOTE: Anytime a monitor has been plugged in for voltage checks or for any other purpose, the CRT high voltage must be discharged before attempting any other troubleshooting or repair activity.)

TROUBLESHOOTING
UNIT X

NAME ________________________

TEST

1. Match the terms on the right with their correct definitions.

_____a. A problem involving both hardware and software

_____b. A problem that occurs only part of the time or at irregular intervals

_____c. A general reference to a printed circuit board

_____d. Having to do with the senses of seeing, hearing, feeling, and smelling

_____e. A logical testing procedure used to isolate a problem with speed and reliability

1. Module
2. Intermittent problem
3. Systematic routine
4. Interaction problem
5. Sensory

2. Complete the following list of general guidelines for troubleshooting by circling the word(s) that best completes each statement.

a. Use the customer conference to good advantage:

1) Listen carefully as the customer describes the problem, and (**remember, keep notes of**) what the customer says

2) Try to determine what happened just (**before, after**) the malfunction, if the equipment has been subjected to unusual usage, if it has been recently moved, and questions pertinent to the problem described

3) Make sure notes from the customer conference are kept with the equipment or passed on to the (**clerk, technician**) who will work on the equipment

b. Try to duplicate the problem by setting up the equipment (**different from the, the same**) way it was being used to see if it will duplicate the problem described by the customer

c. Check for the obvious (**first, last**) — poorly connected or disconnected cables and plugs and blown fuses

d. Once a problem is verified, use the manufacturer's technical data or repair guide to set up a (**systematic, random**) troubleshooting routine, or, in the absence of technical guides, use a troubleshooting routine best suited for the problem

TEST

3. Complete the following statements concerning basic techniques for troubleshooting by inserting the word(s) that best completes each statement.

   a. __________ to __________ — A technique whereby a component or subsystem is checked by starting at a terminating point and moving back to each critical point in sequence so the starting point is checked last

   b. __________ __________ — A technique whereby a known variable such as voltage or current is checked at the half-way point in a unit or subsystem, and if it is correct, one half of the system is eliminated as a problem and the other half is then split to isolate the problem in a given quarter of the system

   c. __________ components that are known to be good with components that are suspected of being faulty is another common technique in troubleshooting

4. Complete statements concerning a typical forward to back troubleshooting routine by inserting the word(s) that best completes each statement.

   a. Assuming that half splitting has isolated the problem to the audio system of the microcomputer, the procedure would be:

      1) Start at the __________ and inject a signal from an audio test generator

      2) If the speaker or sounder __________ the sound,

         a) Move back a stage, inject another audio test signal, and if the speaker or sounder reproduces the sound, it indicates that all points between that stage and the speaker are okay

         b) Move back another stage and repeat the procedure

      3) If the speaker or sounder __________ __________ reproduce the sound,

         a) The trouble is isolated in the speaker or sounder

         b) The trouble is in the driver stage for the speaker

   b. An alternate to the forward to back routine is to start forward, but then start __________ __________ when checking back through the stages

   c. Once the problem has been isolated to a specific printed circuit card, pull the card and replace it with __________

TEST

5. Complete the following statements concerning sensory troubleshooting by inserting the word(s) that best completes each statement.

   a. ____________ to see if any parts are broken or missing or if any IC's, boards, cables, or other parts are loose

   b. ____________ the equipment for the obvious odors given off by burned transformers, capacitors, and resistors

   c. ____________ for unusual sounds from the equipment like the buzzing sound sometimes caused by a bad connection or just before a transformer goes out

6. Arrange in order the steps in the first routine after sensory troubleshooting by placing the correct sequence numbers (1-11) in the appropriate blanks.

   _____a. Once correct voltage is established at the power supply, remove all external peripherals not required to evaluate the problem

   __5__b. Proceed with a half-splitting technique to isolate other subsystem problems

   _____c. Remove all peripherals and turn the computer on

   _____d. Check to see if the recommended voltage is present at the output of the power supply as indicated in the OEM tech manual

   _____e. Use a voltmeter to make the voltage check and make sure it agrees with the output specified by the manufacturer

   _____f. If the voltage is significantly under or over, do not proceed until the power supply voltage is corrected, which may mean changing out the power supply

   _____g. The computer and peripherals should work, and the faulty peripheral should be returned to a service center for repair

   _____h. If all peripheral devices have been removed and the computer does not work when it is turned on again, swap out the main board and the computer should work

   __7__i. If the computer works, it means one or more peripheral devices are overloading the system

   _____j. Add peripheral devices one at a time until you reach the one that causes the overload

   _____k. Swap out the peripheral device causing the overload with a known good device and turn the computer back on

TEST

7. Complete the following statements concerning troubleshooting when the operating system will boot up by inserting the word(s) that best completes each statement.

   a. If the computer will boot up the operating system:

      1) Read ____________ for operating the diagnostic disk

      2) ____________ a diagnostic disk properly

      3) Run diagnostics to check main board for normal ROM and RAM functions and certain ____________ functions

      4) If diagnostics indicate ROM or RAM failure, ____________ ROM and/or RAM

      5) Check keyboard by presenting ____________ ____________ suggested by manufacturer, and press user keys to check for malfunctions

      6) If key malfunction is discovered, replace the keyboard with a keyboard ____________ ____________ ____________ in good operating condition

   b. Use diagnostic disk to check the video system

      1) If system if ____________, it will check for the presence of all colors and character and graphic generation capabilities

      2) If the system is ____________, it will check low, medium, and high resolution and character and graphic generation capabilities

   c. Use the disk drive diagnostic to check the disk drive

      1) Test is simply a "____________" or "____________" test and will indicate when the disk drive is not working right, but it won't indicate what the problem is

      2) If test results in a "____________", then pull the disk drive and replace it with a disk drive known to be in good operating condition

8. Complete the following statements concerning troubleshooting when the system will not boot up by inserting the word(s) that best completes each statement.

   a. Check the ____________ ____________ for proper voltage, and make all visual and audio checks that can be made

   b. Double check cable ____________ and make sure all parts are in place and properly seated

   c. If the system will not initialize, the problem is probably in the ____________

   d. At this level of troubleshooting, changing out the ____________ is the quickest and best course of action

TEST

e. If the system will initialize, but still fails to boot up the operating system, then:

1) Check the ____________ ____________ cards for proper voltage and be sure IC's are firmly seated

2) Check the ____________ ____________ for proper voltage supply and good cable connections

3) Substitute ____________ ____________ ____________ for disk drive or disk controller card and this should get the system working

f. If the system will still not boot up the operating system after all voltage checks and controller card/disk drive substitution:

1) Change out the ____________ ____________

2) If main board and CPU are separated, change out the ____________ first and make a test, and change out ____________ ____________ only if needed

9. Select true statements concerning intermittent problems by placing an "X" in the appropriate blanks.

(NOTE: For a statement to be true, all parts of the statement must be true.)

_____a. Determine the part(s) of the system affected by the intermittent condition

_____b. Isolate the part, then check all connections

_____c. The intermittent condition can usually be stopped by wiggling or reseating connections

_____d. When pressing a printed circuit board tightly into its connections stops the intermittent problem, the board should be removed and the edge connectors cleaned with a pencil eraser

_____e. When the intermittent problem is traced to a printed circuit board and the problem can be stopped by "flexing" the board, this usually means the board is cracked or a soldered joint has become bad

_____f. When "flexing" a board is the only way to get it to work, the board should be returned to a repair center, but information concerning what was done to get the board to work should be sent along to save more troubleshooting time

TEST

10. Complete the following statements concerning intermittent and other problems related to overheating by inserting the word(s) that best completes each statement.

    a. Intermittent problems associated with components such as IC's and capacitors may occur only after the system has run for a certain length of time, and this frequently indicates a problem with ____________

    b. Both IC's and capacitors have a tendency to ____________ when they are overheated, but may operate normally after they cool off

    c. Checking for an overheating problem requires using a ____________ ____________ ____________ systematically

    d. When a system is completely loaded with boards and an intermittent problem occurs only after periods of extended operation, the cause probably is poor ventilation and the solution will probably require installation of ____________ ____________ ____________

    e. Since cooling can be used to isolate a bad component, so can ____________

11. Complete the following statements concerning record keeping for module replacement by inserting the word(s) that best completes each statement.

    a. New modules used to replace bad modules should be recorded by ____________ and ____________ ____________ on whatever label is used to identify the module

    b. In addition to the above, the routine or technique used to correct the problem should also be summarized and recorded on a card or sheet that is placed with other records in the computer ____________ file

12. Complete the following statements concerning ways to determine if a module should be replaced by inserting the word(s) that best completes each statement.

    a. Make a thorough check of the ____________ in the system

    b. In the case of main boards, a good check is to run a ____________ ____________ because it will usually point directly to the memory part that needs replacing

    c. Check boards such as memory boards, communication boards, and video boards for special switches or blocks of small switches:

        1) Make sure switch settings agree with ____________ recommendations

        2) Move the switches back and forth several times to ____________ ____________ on switches that may have become oxidized or corroded in an environment subjected to corrosive vapors or smoke

TEST

d. Refer to notes from the initial customer conferences to determine if the problem occurred immediately after a change or ____________ to equipment

e. Check board switch settings for possible improper settings; when no conflicts in switch settings are found, chances are the problem is in the ____________

13. Select true statements concerning unloading the system by placing an "X" in the appropriate blanks.

(NOTE: For a statement to be true, all parts of the statement must be true.)

_____a. Rule number one for unloading a system is: ALWAYS INSERT AND REMOVE A BOARD WITH THE POWER ON

_____b. Use a standard procedure to determine the need for module replacement:

1) If the microcomputer has a full or nearly full complement of boards

2) If the problem does not appear to be associated with all the boards

3) Then, the boards that are not suspect can be removed from the system to "unload" the power supply

4) Unloading will also allow the suspect boards to operate without interaction with boards that apparently are not causing the problem

_____c. If removing the boards changes the characteristics of the problem, there is a possibility that:

1) An improper interaction exists between two or more boards

2) The power supply is being loaded excessively

_____d. To check for excessive power supply loading, monitor the voltage supplied to the suspect board(s) as the remaining boards are added or removed from the circuit

14. Complete the following statements concerning hardware vs. software problems by inserting the word(s) that best completes each statement.

a. When all sections of related hardware are operating normally, and there is still a problem with the operating system, the problem may be in ____________

b. Whether disk or tape, magnetic media is easily subject to damage from ____________

c. The quickest way to solve an OS problem when software is suspect is to obtain and run a ____________ disk or tape

TEST

d. Sometimes the problem can be an interaction problem between ____________ and ____________

e. Interaction problems usually occur when there is an underlying problem in either software or hardware and the problem may present itself in the following way: (several answers are possible — give one)______________________________

____

f. One of the tricky elements with an interaction failure is that software will work properly on one system and then fail to work on what appears to be an ____________ system

g. Best approach to an interaction problem is to ____________ system parts until the problem is duplicated in the target system, and that will identify the point of failure

h. Interaction problems related to ____________ simply require interchanging software to isolate the problem software

15. Complete the following list of ways to handle media problems by inserting the word(s) that best completes each statement.

a. When all hardware is working perfectly and some feature of a program fails to work or works improperly, chances are it is a ____________ problem

b. Media problems can occur with disks or tapes, and in some cases, ____________ can create a problem similar to a media problem

c. When the media problem is with a disk, it is common practice to initialize the suspected disk a ____________ time so the initialization procedure will pinpoint faulty sections on the disk

d. When a disk is found to be free of faulty sections, the ____________ program can be copied from the backup onto the reinitialized disk

e. When the media problem is simply a bad tape, ____________ ____________ ____________

f. When the media problem is in a ____________ cartridge that malfunctions as temperature increases or changes, the only solution is to replace the entire cartridge

TEST

16. Select true statements concerning keyboard problems and lockouts by placing an "X" in the appropriate blanks.

_____a. The disk or ROM diagnostics provided by the manufacturer will normally allow a check of the key functions for proper key closure (or activation of a switch) and, in some cases, if the key has a repeat function, the diagnostics will indicate whether or not it is working

_____b. When a key fails and a good keyboard is substituted, and the key will still not function, check for bad contact points

17. Complete the following statements concerning troubleshooting monitor problems by inserting the word(s) that best completes each statement.

a. Always check for the possibility that a ____________ control has been inadvertently turned out of adjustment

b. Never assume that the monitor is bad until it has been established that the proper signal is reaching the monitor, and the best way to do this is to

____

c. If no signal is present after monitor substitution, check the cable by substituting a good cable or by doing a ____________ check from one end of the cable to the other

d. If there is still no signal after cable substitution, and there is a driver section or driver card in the computer, then check it to make sure the ____________ is compatible with the smaller driver

e. If the micro drives a TV set as a monitor, there will probably be an RF adapter and an attenuator between the computer and the TV set, and these should both be checked by ____________

f. When there is still a monitor problem after the signal, cable, and driver card have been checked, then the monitor itself should be ____________

18. Arrange in order the steps in correcting monitor problems by placing the correct sequence numbers (1-7) in the appropriate blanks.

_____a. Once the unit is safe to enter, TAKE THE MONITOR COVER OFF WITH EXTREME CARE

_____b. If replacing modules does not correct the problem or there are no modules and no broken or burned parts, then the monitor should be returned to a repair center

__5__c. Once the monitor case is opened and interior equipment exposed, inspect the monitor visually for burned or broken parts

TEST

______d. If there are modules inside the monitor, do a module replacement routine as previously outlined

______e. Once the problem has been clearly identified as a monitor problem, run a monitor diagnostic disk and make adjustments as indicated by the diagnostic pattern that the program put on the screen

______f. When suggested adjustments with the diagnostic pattern do not solve the problem, then the monitor case has to be opened

______g. UNPLUG THE UNIT AND ALLOW IT TO SIT FOR AT LEAST ONE HOUR BEFORE OPENING THE MONITOR CASE

19. Select true statements concerning monitors with screen RAM problems by placing an "X" in the appropriate blanks.

______a. In some cases, the monitor may have a section of RAM that is dedicated to information to be presented on the video display

______b. A good diagnostic disk should check screen RAM, but if there is doubt that the diagnostic has made the proper check, then make a substitution check of the chips in the memory section where screen RAM is located

20. Complete the following statements concerning disk drive characteristics and problems by inserting the word(s) that best completes each statement.

a. Because disk drives are normally used ____________ ____________ than other peripherals, they are subject to more wear and are frequently the source of problems with microcomputer systems

b. Problems very common to disk drives of all makes include the following: (several answers are possible — give one) ________________________________

____

c. One of the first rules for troubleshooting disk drives is to make sure the problem is not a ____________ problem

d. When the problem with motors has been eliminated, a diagnostic disk should be run on the drive, but to assure that the diagnostic runs properly, the ____________ ____________ should first be properly cleaned

e. Since cleaning the head on a drive involves partial disassembly of the drive, it is a good time to clean and lubricate the ____________ ____________ and clean dirty connectors

TEST

21. Select true statements concerning troubleshooting disk drive motors by placing an "X" in the appropriate blanks.

_____a. Insert a disk and listen for the sound of the drive motor running, and also listen for the stepper motor that steps the head in and out of the various tracks on the disk

_____b. If the disk insert slot is not completely blocked by the door, shine a penlight flashlight into the drive to make sure the disk is turning

_____c. If any of these checks prove that the disk drive motor or the stepper motor that drives the head are not operating, then the drive must be removed and the head aligned

22. Arrange in order the steps in removing disk drives by putting the correct sequence numbers (1-7) in the appropriate blanks.

_____a. Lift the computer case carefully off the frame and beware of hitting the CRT or other components as you remove the case

_____b. Remove the screws that hold the first drive in its metal mounting brackets and put the screws aside in order for reassembly

_____c. If required, repeat the procedure for the second drive and place both drives aside for cleaning, lubricating, and reassembly

_____d. On systems where the drive(s) is integrated, unplug the microcomputer at least one hour before working on the system or safety discharge high voltages

_____e. Remove the screws that hold the computer case to the frame, and be sure to keep the screws in order for reassembly

_____f. Unplug the ribbon cable and the power supply line to the first drive

__5__g. Check for a ground wire on the first drive and disconnect or loosen as required

23. Select true statements concerning steps in cleaning and lubricating disk drives by placing an "X" in the appropriate blanks.

_____a. After the disk drive has been properly removed and disconnected, remove the screws or holders from the logic board on top of the drive

_____b. Unplug the head connector before attempting to move the top logic board, and if it is a double-sided drive, there will be two head connectors, so be sure to keep track of where they go

_____c. Turn the logic board over gently so that it folds out as far as possible and provides convenient access to the head and to the guide rails the head rides on

TEST

______d. Close the drive door before attempting to clean the head

______e. Saturate a cleaning swab with water, start along the stripe in the middle of the head where the read/write area is located, and work out away from the center of the head as you clean

______f. While cleaning heads and pads, inspect them to make sure they're in good condition, and if pads need to be replaced, do it at this time, or make a note of it so the pads can be replaced if the drive should be sent to a service center

______g. Saturate another cleaning swab with gasoline and clean both of the guide rails

______h. Lightly dampen another cleaning swab with a silicon lubricant and lubricate the guide rails lightly

______i. Reconnect the head connectors to the drive's top logic board, or if it is a double-sided drive, reconnect both head connectors exactly where they were removed

______j. Put the logic board back on top of the drive frame and put screws in finger tight

______k. Connect the power supply to the drive and make sure it is firmly seated

______l. Check the edge connector on the ribbon cable connection, and if the edge connector appears tarnished, clean it with alcohol and a cleaning swab before reconnecting it

______m. Place the drive back in its mounting brackets, but don't tighten screws firmly yet

______n. Plug the computer in and turn it on, and if the light comes on and the drive steps back to track zero, the cleaning is complete

______o. All screws in the top logic board can be tightened, the drive or drives can be replaced in their brackets and secured, and the drive is ready to run a diagnostic disk

24. Complete the following statements concerning troubleshooting disk drive speed problems by inserting the word(s) that best completes each statement.

a. After checking the disk drive motor and the stepper motor, run a diagnostic disk first to get a video display of specific problems with the drive such as (several are possible — give one)______________________________

____

b. If the diagnostics indicate a drive speed problem, it can be verified by using a __________ __________ __________ which will indicate on the video display whether the speed is too fast or too slow

TEST

c. When the problem has been clearly identified as a drive speed problem, chances are the speed ____________ ____________ ____________ and the drive will not have to be sent away for repair

25. Select true statements concerning steps in adjusting disk drive speed by placing an "X" in the appropriate blanks.

(NOTE: For a statement to be true, all parts of the statement must be true.)

_____a. Turn the computer on and read the manufacturer's instructions for this procedure if they are available

_____b. Remove the computer case, if the system is integrated, and save all screws for proper reassembly

_____c. With the disk drive exposed, remove the screws that hold the drive in its frame

_____d. Remove the ribbon cable connector that provides control signals and unplug the four-wire power connection

_____e. Place the drive on a clear, clean work area so that the ribbon cable and power supply cable can be reattached so the drive can be safety operated again

_____f. If the ribbon cable or the power supply cable are not long enough to permit convenient operation of the drive, use "extender cables" as required

_____g. Make sure a flashlight is available at the work area to check the strobe pattern on the disk drive flywheel

_____h. Turn the computer on and put the drive into continuous operation while exposing the flywheel to the flashlight

_____i. Determine from the strobe pattern on the flywheel that adjustment is required

_____j. Double check with manufacturer's recommendations, and make the required adjustment by turning the adjustment potentiometer only to the left

_____k. Adjust the potentiometer so that the strobe pattern on the flywheel seems to stand still at 120 cycles per second

_____l. Check the belt on the large pulley by grabbing it on the underside of the pulley and holding it with your fingers:

1) If this causes the motor to stall, the belt should be replaced

2) If the belt stays in place and motor still runs, the belt is okay

TEST

______m. Turn the computer off

______n. Check the ribbon cable connection to the drive and if it looks tarnished, clean it with a silicon lubricating cleaner on a cotton swab

______o. Secure disk drive in its frame, replace drive and cables, and replace and secure the computer case

______p. Turn computer on again and run the diagnostics to double check for proper disk drive speed

26. Complete the following statements concerning troubleshooting disk drive controller problems by inserting the word(s) that best completes each statement.

    a. When all checks have been made and disk drive(s) continues to have errors, the problem may be with the ______________ ______________

    b. The first check on a controller should be to clean the contacts on the controller card and then reset the ______________

    c. The next step should be a check of all _____ _________ ______________ for proper seating

    d. Cable continuity should also be checked by taking the cable(s) loose at both ends and using a/an ______________ to check from the pin on one connector to the corresponding pin on the other connector

    e. Finally, a bad controller can be identified by ______________ it out with a known good controller

27. Select true statements concerning printer problems by placing an "X" in the appropriate blanks.

______a. Next to CPUs, printers are subjected to more mechanical wear than other parts of a microcomputer system, but a printer failure is far more likely to be electronic than mechanical

______b. The first step in troubleshooting a malfunctioning printer is to determine if the trouble is a mechanical problem or an electronic problem involving the logic components of the printer

28. Complete statements concerning a basic printer troubleshooting routine by inserting the word(s) that best completes each statement.

    a. When a printer will still operate, follow directions from the user's manual and set up the required operating sequence for the printer to perform a ______________ ______________ program

    b. Once the printer is operating, observe the printer in action and evaluate the ______________ it makes according to information from the user's manual

TEST

c. When it appears that the printer is physically sound enough to properly run the complete diagnostics, the trouble is probably in the ____________ ____________

d. The best way to check this is to ____________ known good parts and test the printer again

e. Watch for microcomputers that have multiple jacks at the back of the machine because some of these jacks are for ____________ printers and some for serial printers, and there may be other jacks similar in appearance that are not for printers at all

f. When there are multiple jacks at the back of the microcomputer, check the ____________ ____________ for the correct connections, and never assume that the customer has the cable in the proper jack

29. Complete the following statements concerning common printer mechanical problems and their solutions by inserting the word(s) that best completes each statement.

a. Paper feed problems

1) A common printer problem, but more so with printers that have both ____________ and ____________ ____________ capabilities

2) Best solution is to check ____________ ____________ for cleaning and adjustment procedures

3) When friction feed parts are broken or missing, printer should be ____________ ____________ ____________ ____________ ____________

b. Ribbon problems

1) Many printers have specialized ribbon containers that look like commercial typewriter ribbon containers, and some people use regular commercial ribbons in order to ____________ ____________

2) Some ribbons are also lightly oiled so the print head will be lubricated as it is used, and ____________ ____________ ____________ will lead to early print head failure

3) Subtle differences between a commercial typewriter ribbon and a printer ribbon could cause the ribbon to wind around the ribbon feed instead of around the take-up spool, and the printer may ____________ ____________ ____________ before the problem becomes apparent

4) Best solution to all ribbon problems is to remove the ____________ ribbon, put the ____________ ribbon in the printer, and encourage the customer to use only printer ribbons recommended for the printer

TEST

c. Print head problems

1) A print head that wears out is a common problem on dot matrix printers, and the problem will usually evidence itself early by loss of parts of the ____________ so that part of a character no longer appears on the printed image

2) The solution for a worn print head is to ____________ ____________ ____________ ____________

30. Complete the following list of steps in troubleshooting a computer that will not drive a good printer by inserting the word(s) that best completes each statement.

a. If the printer has no mechanical problems, and if the diagnostics run but the computer will still not drive the printer, substitute a known good ____________ first, and then substitute a known good printer

b. If the signal from the computer is capable of driving a known good printer then the problem printer should be ____________ ____________ ____________ ____________ ____________ for repair

c. If the signal from the computer will not drive a known good printer, and the cable has been verified as a good cable, and the cable is in the right jack, then the trouble is probably in the ____________ ____________ ____________

d. When the printer driver is part of a multifunction card, it is sometimes possible to insert an ordinary printer drive card and run the printer from a ____________ ____________

e. When changing out a multifunction driver for an ordinary driver card, always check manuals carefully because such a change also requires changing ____________ settings on the printer board, the main board, and the multifunction board

f. When changing out printer driver cards, also beware of ____________ switching commands that may be used to cue a particular card slot because the software will have to be changed to reflect the printer signal/card slot relationships

31. Select true statements concerning other areas of software/printer problems by placing an "X" in the appropriate blanks.

______a. Some sophisticated software such as word processors, spread sheets, and data bases, require that the software be installed for a specific printer

______b. When software is "installed" in this manner, it means that the conditions are set up in the software to mate with the data speed, handshaking, and other protocol required for a specific printer

______c. When a customer complains that the printer works fine on everything but "new software", the customer should be told of the requirement for software "installation" which is a matter of running a set procedure in software and storing it back in the program

TEST

32. Complete the following statements concerning printer handshakes by inserting the word(s) that best completes each statement.

    a. Occasionally, the printer driver card or the printer driver section of the computer has been set to originate and react to what are known as "handshake signals" that are sent ____________ and ____________ the printer

    b. Handshakes are easily accomplished on two or three electrical lines so that electrical signals can:

        1) ____________ to the printer that a character is being sent

        2) ____________ to the computer that a character has been received and that the computer can send another character

    c. The most common signal arrangement is called the "____________ ____________", so when you hear or read a reference to that standard it is a reference to the electrical signal exchange between the computer as to when information is exchanged back and forth between the two

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

33. Demonstrate the ability to:

    a. Check voltage on a microcomputer power supply. (Job Sheet #1)

    b. Troubleshoot a microcomputer that will not boot up. (Job Sheet #2)

    c. Check and replace faulty modules in a microcomputer system. (Job Sheet #3)

    d. Troubleshoot a malfunctioning floppy disk drive. (Job Sheet #4)

    e. Troubleshoot a microcomputer keyboard. (Job Sheet #5)

    f. Troubleshoot a malfunctioning microcomputer monitor. (Job Sheet #6)

    g. Troubleshoot a malfunctioning printer. (Job Sheet #7)

    h. Discharge high voltage from a CRT. (Job Sheet #8)

TROUBLESHOOTING
UNIT X

ANSWERS TO TEST

1. a. 4
   b. 2
   c. 1
   d. 5
   e. 3

2. a. 1) Keep notes of
      2) Before
      3) Technician
   b. The same
   c. First
   d. Systematic

3. a. Forward to back
   b. Half splitting
   c. Swapping

4. a. 1) Speaker or solid state sounder
      2) Reproduces
      3) Does not
   b. Half splitting
   c. A new one

5. a. Look
   b. Smell
   c. Listen

6. a. 4
   b. 5
   c. 6
   d. 1
   e. 2
   f. 3
   g. 10
   h. 11
   i. 7
   j. 8
   k. 9

7. a. 1) Instructions
      2) Insert
      3) I/O
      4) Replace
      5) Keyboard pattern
      6) Known to be

ANSWERS TO TEST

- b.
  - 1) RGB
  - 2) Monochrome
- c.
  - 1) Go, no go
  - 2) No go

8.
- a. Power supply
- b. Connections
- c. CPU, or the interrupts associated with the CPU
- d. CPU or main board
- e.
  - 1) Disk controller
  - 2) Disk drive
  - 3) Substitute known good parts
- f.
  - 1) Main board
  - 2) CPU, main board

9. a,b,c,e,f

10.
- a. Overheating
- b. Fail
- c. Spray circuit cooler
- d. An appropriate fan
- e. Heating

11.
- a. Name, serial number
- b. History

12.
- a. Boards
- b. Diagnostic disk
- c.
  - 1) Manufacturer's
  - 2) Improve contact
- d. Addition
- e. Board

13. b,c,d

14.
- a. Software
- b. Heat, dust, smoke, or magnetic fields
- c. Backup
- d. Hardware, software
- e. One of the following:
  - 1) Failure to print properly
  - 2) Improper or incomplete video display
  - 3) Disk drive failure
  - 4) Failure to store pages correctly
- f. Identical
- g. Interchange
- h. Software

ANSWERS TO TEST

15. a. Media
    b. ROM or an EPROM
    c. Second
    d. Original
    e. Replace the tape
    f. ROM

16. a

17. a. Contrast or brightness
    b. Substitute a known good monitor
    c. Continuity
    d. Monitor
    e. Substitution
    f. Monitor adaptor
    g. Checked

18. a. 4
    b. 7
    c. 5
    d. 6
    e. 1
    f. 2
    g. 3

19. a,b

20. a. More often
    b. One of the following:
        1) Dirty heads
        2) Speed problems
        3) Alignment problems
    c. Disk drive motor or stepper motor
    d. Drive head
    e. Guide rails

21. a,b

22. a. 3
    b. 6
    c. 7
    d. 1
    e. 2
    f. 4
    g. 5

23. a,b,c,f,i,j,k,l,m,n,o

ANSWERS TO TEST

24. a. Any one of the following:
    1) Incorrect drive speed
    2) Failure to go to zero track
    3) Failure to step the head
    b. Speed-check disk
    c. Can be adjusted

25. b,c,d,e,f,i,m,o,p

26. a. Disk controller
    b. Card
    c. Cable connections
    d. Ohmmeter
    e. Swapping

27. b

28. a. Self-diagnostic
    b. Pattern
    c. Driver card or connecting cable
    d. Substitute
    e. Parallel
    f. User's manual

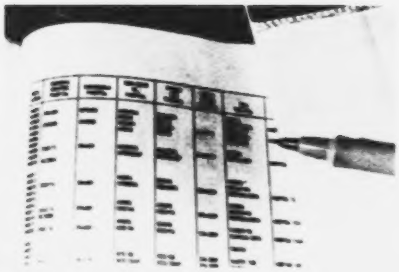
29. a. 1) Friction, pin feed
    2) User's manual
    3) Returned to a repair center
    b. 1) Save money
    2) Improper ribbon selection
    3) Run several hours
    4) Improper, right
    c. 1) Matrix
    2) Install a new one

30. a. Cable
    b. Returned to a service center
    c. Printer interface card
    d. Separate driver
    e. Switch
    f. Software

31. a,b,c

32. a. To, from
    b. 1) Announce
    2) Reply
    c. Centronics Standard

33. Competencies evaluated according to procedures outlined in the job sheets



PARTS AND SUPPLIES
UNIT XI

UNIT OBJECTIVE

After completion of this unit, the student should be able to identify chips, discuss parts manuals and cross referencing, list procedures for properly ordering parts, and be able to roll in and seat a dual in-line IC. These competencies will be evidenced by correctly completing the procedures outlined in the assignment and job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to parts and supplies with their correct definitions.
2. Complete statements concerning how to identify chips.
3. Complete statements concerning how to identify speed on memory chips.
4. Select true statements concerning guidelines for inserting chips.
5. Complete statements concerning parts listings and parts manuals.
6. Select true statements concerning cross referencing.
7. Complete statements concerning guidelines for handling and shipping static-sensitive parts.
8. Solve problems concerning guidelines for handling and shipping floppy disk drives and printers.
9. Complete statements concerning special considerations for handling hard disk drives.
10. Select true statements concerning importance of quality parts and supplies.
11. Complete statements concerning important points in parts record keeping.
12. Solve problems concerning replacement parts. (Assignment Sheet #1)
13. Order parts from a parts catalog. (Assignment Sheet #2)
14. Demonstrate the ability to roll in and seat a dual in-line IC. (Job Sheet #1)

PARTS AND SUPPLIES
UNIT XI

SUGGESTED ACTIVITIES

A. Provide student with objective sheet.

B. Provide student with information, assignment, and job sheets.

C. Discuss unit and specific objectives.

D. Discuss information sheet.

E. Discuss procedures outlined in the assignment sheets.

F. Discuss and demonstrate the procedures outlined in the job sheet, and use this job sheet to not only show the IC insertion procedure, but to emphasize again the need for antistatic protection around IC components.

G. Since this is the last unit of the text, encourage students to continue their studies in computer service and repair, and briefly review the contents of MAVCC's *Advanced Microcomputer Service Technician* and *Microcomputer Peripheral Service Technician.*

H. Give test.

CONTENTS OF THIS UNIT

A. Objective sheet

B. Information sheet

C. Assignment sheets

  1. Assignment Sheet #1 — Solve Problems Concerning Replacement Parts

  2. Assignment Sheet #2 — Order Parts From a Parts Catalog

D. Answers to assignment sheets

E. Job Sheet #1 — Roll In and Seat a Dual In-Line IC

F. Test

G. Answers to test

REFERENCES USED IN DEVELOPING THIS UNIT

A. *Semiconductor General-Purpose Replacements* (Fifth Edition). Indianapolis, IN 46268: Howard W. Sams & Co., Inc., 1985.

REFERENCES

B. *Computer Supplies Catalog.* Hartford, CT 06104: Wheeler Group, Inc., 1984.

C. *SAMS Computerfacts™ CSCS2 Computer: IBM® PC5150.* Indianapolis, IN 46268: Howard W. Sams & Co., Inc., 1985.

PARTS AND SUPPLIES
UNIT XI

INFORMATION SHEET

I. **Terms and definitions**

A. Consumable — Any item that is more expensive to repair than a new replacement would cost, or an item that cannot be repaired and must be replaced with a new one

B. Cross reference — A list of components that can be safely interchanged or generic components that can be substituted for OEM components

C. DIP — Dual in-line package

D. Generic product — A product that duplicates the performance of a brand name product and is usually lower priced

E. OEM — Original equipment manufacturer

F. X-ray damage — A problem at inspection stations in airports where X-ray equipment used for examining luggage erases software or causes other problems with computer components

II. **How to identify chips**

A. Proper identification of chips requires knowing the code used by the manufacturer of the chip

B. The code marks are numbers or letters that provide:

1. A basic part or device number

2. Name of the manufacturer

3. Date of manufacture

4. The speed of the device when the device is a memory part and knowing the speed is critical

5. There are other numbers used for production control data, and significant only to the manufacturer or as an engineering reference

INFORMATION SHEET

C. Most microprocessor and support IC chips have identifying marks printed on their cases

Example: Chip ID info: R65C02-P1
8410

Means:
R = Rockwell version of a 6502 microprocesor
C = CMOS version
P1 = First generation, plastic case
8410 = Produced 10th week of 1984

III. How to identify speed on memory chips

A. In many common parts, it is critical to know the access time of the memory as expressed in nanoseconds

B. It is a general rule that a memory chip may be replaced only with a chip that has an access time equal to or less than the original chip

Example: If a system requires a memory with an access time of 200 nanoseconds, a 250 nanosecond memory could not be used as a replacement, but a memory with a 150 nanosecond access time could be used

C. Access time of memory parts may vary from 150 nanoseconds up to 450 nanoseconds

Example: Chip ID info: MCM4116C-20

Means:
MCM = Motorola computer memory
4116 = Part number
C = Ceramic case
-20 = 200 nanosecond access time

D. Use chips of the same speed in a bank of memory

IV. Guidelines for inserting chips

A. Integrated circuit parts are about the only parts in a computer system that can be inserted, and the procedure is relatively easy, but the preparation requires care

B. Many MOS and CMOS parts can be damaged by static electricity, so unless you know exactly what part you are dealing with, treat it as if it could be damaged by static electricity

C. Work with IC parts on a static-free piece of aluminum foil spread out on the work bench or a manufactured static mat

INFORMATION SHEET

D. Integrated circuit parts in a dual in-line package require special handling

E. Remember that these dual in-line parts have the pins spread beyond the normal distance required for insertion and require special preparation before insertion

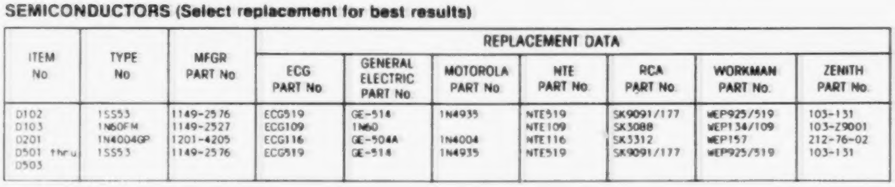
F. Pins on dual in-line IC parts should be rolled in with pressure from side to side, and then seated with pressure from end to end

(NOTE: Job Sheet #1 which follows this information sheet presents this special procedure in a step by step sequence.)

V. **Parts listings and parts manuals**

A. Parts for microcomputers are usually listed as a section of either a technical or maintenance manual, but may sometimes be listed in a separate parts manual (Figure 1)

FIGURE 1



SEMICONDUCTORS (Select replacement for best results)

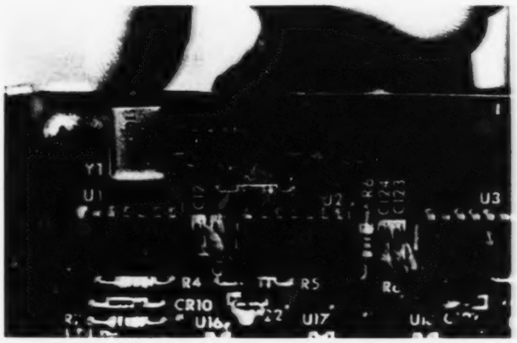
ITEM No	TYPE No	MFGR PART No	REPLACEMENT DATA						
			ECG PART No	GENERAL ELECTRIC PART No	MOTOROLA PART No	NTE PART No	RCA PART No	WORKMAN PART No	ZENITH PART No
D102	1SS53	1149-2576	ECG519	GE-514	1N4935	NTE519	SK9091/177	WEP925/519	103-131
D103	1N60FM	1149-2527	ECG109	1N60		NTE109	SK3088	WEP134/109	103-Z9001
D201	1N4004GP	1201-4205	ECG116	GE-504A	1N4004	NTE116	SK3312	WEP157	212-76-02
D501 thru D503	1SS53	1149-2576	ECG519	GE-514	1N4935	NTE519	SK9091/177	WEP925/519	103-131

Courtesy Howard W. Sams & Co., Inc.

B. To use a parts manual or listing properly first requires proper identification of the part number

C. Part numbers on printed circuit boards are frequently silk-screened onto the boards, but when they are not, a schematic should be used for proper part identification (Figure 2)

FIGURE 2



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INFORMATION SHEET

D. Although there are no real standards for prefix letters that identify parts, some of the common prefixes are:

  1. C — Capacitors
  2. Q — Transistors
  3. R — Resistors
  4. T — Transformers
  5. U — Integrated circuits

E. Be certain of what the prefix means, then the part will be easy to find in the parts manual or listing

Example: If the part had a prefix of "U", followed by the number 230, the part would probably be listed under "Integrated Circuits" as part #230

F. Along with the listing of the manufacturer's part number, there may also be a generic part number or a special manufacturer's part number to indicate a part that can be used as a substitute

(NOTE: Should a generic number or other number not be referenced, it usually means the part is manufactured only by the OEM and there are no generic or special parts suitable for replacement.)

G. Play it safe when ordering replacement parts by including the model number of the equipment, the part number, and a description of the part

VI. **Cross referencing**

A. Cross referencing provides a handy guide for common parts such as resistors, capacitors, and common logic IC's that are available locally and do not have to be ordered from a specific manufacturer

(NOTE: These items that are readily available locally will usually be listed by item number but will probably not have a manufacturer's part number listed.)

B. Cross references seldom appear in user manuals or tech manuals, but they appear in maintenance materials from several manufacturers

C. Many manufacturers supply parts lists cross references to their distributors, and these parts are usually available from a parts supplier

D. Several specialized parts lists such as those that cross reference Japanese and American parts are produced and sold by various publishers

(NOTE: Howard W. Sams has several of these publications.)

INFORMATION SHEET

VII. **Guidelines for handling and shipping static-sensitive parts**

A. Consider all computer parts and components as fragile and handle and pack them with care

B. Be especially careful of handling and storing static-sensitive IC's, and never remove the static-proof coverings from such parts, even when the parts are going to be stored in a drawer

C. Handle EPROM's with the same care given other IC's, but as an extra precaution, EPROM's should be sealed from light of any kind

(NOTE: EPROM's can normally be erased only by ultraviolet light, but sunlight and artificial light both contain some ultraviolet light, and an EPROM left exposed for a period of time could be totally or partially erased, and if only one bit of an EPROM is erased, it is no longer of value except as a part that can be reprogrammed.)

D. IC's, EPROM's, or boards in general that are shipped by air should be packaged for protection against X-ray damage with an X-ray protection bag or a photo protection bag

VIII. **Guidelines for handling and shipping floppy disk drives and printers**

A. When preparing a floppy disk drive for shipment, be sure to insert the head-protecting cardboard insert that came with the drive, or insert an old floppy disk to keep the head from bouncing around in transit

B. Use a carton and enough packing to protect the drive from exterior damage, and the carton and packing that originally came with the drive should be used, if available

C. When preparing a printer for shipment, be sure to roll paper into the paper path to protect the paper-out switch

D. If a ribbon-type printer is going to be transported very far, it's a good idea to remove the ribbon to avoid the mess that might be caused should the ribbon come loose

E. Use a carton and enough packing to protect the printer from exterior damage, and the carton and packing that originally came with the printer should be used, if available

(NOTE: Follow packing and shipping instructions from the manufacturer when such instructions are available.)

IX. **Special considerations for handling hard disk drives**

A. Anytime a hard disk containing program information has to be shipped away for repair, use another hard disk, floppy disk, or tape to make a backup of the information because the chances are good that the information will be erased in transit

INFORMATION SHEET

B. Whether in or out of a computer, transporting a hard disk drive requires that the drive head first be properly parked, and this is done by the disk controller with software instructions

(NOTE: In other words, you physically have to program a hard disk to park the head, and this is a software function.)

C. If the hard disk is an add-on, ship it in the carton with the packing that came with it, and if it's being shipped in the computer, ship the computer in its original carton complete with packing

(CAUTION: When working with hard disk drives, always remember they are terribly expensive pieces of equipment.)

X. **Importance of quality parts and supplies**

A. Microcomputer parts and supplies can be purchased as OEM or generic products

B. Generic parts are readily available, usually less expensive than OEM parts, and for certain replacement items such as commonly used resistors and capacitors, are sometimes preferred because they are readily available

C. Buying generic parts should be done with caution, and it is not recommended that "bargain" generic parts be purchased from end-of-stock vendors or cut-rate parts houses

D. Using a low quality generic part can be costly if it fails and has to be replaced with an OEM part at the store's expense

E. In cases where a customer requests a generic part in order to save money, it is best to get the customer's written authorization for the substitution

F. In cases where a customer has substituted or jury-rigged a part and does not want an OEM or quality generic part as a replacement, get the customer's written authorization to retain the substitute or jury-rigged part in the system

(NOTE: One of the rules of the road is that if it isn't in writing, it doesn't exist, so all exceptions to good repair policy should be noted and the customer should sign an approval because this is the only way the store and the repair technician can avoid future expenses for problems that could have been corrected earlier with proper procedure.)

G. Some generic parts are of excellent quality, and good buyers learn which generic parts to keep in inventory, but in some cases an OEM part is the only thing to use, and in all cases, computer parts are subject to an age-old rule — you get what you pay for

INFORMATION SHEET

XI. **Important points in parts record keeping**

A. A record should be kept of any part or component that is traded out for a known good part or component, and that record should contain:

1. The part number of the malfunctioning part or component
2. The part number of the known good part or component
3. The serial number of the system into which the known good part is installed

B. A brief description of the problem should also be prepared and signed by the technician who found the problem so that it can be sent along with the bad part to the repair center

C. For all parts that go back to a repair center, copies of the records sent should be kept in the customer file at the store so any questions that may arise at the repair center can be properly referenced at the store

D. All parts taken from an inventory should be properly reported so that a bookkeeper or responsible party can keep all inventories up to date

(NOTE: In many cases, extra copies of the service or repair order are routed to bookkeeping to help with inventory control, but in some stores, inventory control is accomplished with separate forms.)

PARTS AND SUPPLIES
UNIT XI

ASSIGNMENT SHEET #1 — SOLVE PROBLEMS CONCERNING REPLACEMENT PARTS

Directions: Read the following situations carefully and provide the answer that would best solve the problem.

A. A part on an IC board is labeled C102. What replacement part is needed to make a proper repair?

Answer ______________________________

B. A part labeled U117 appears to be faulty. What kind of part does the "U" usually identify?

Answer ______________________________

C. A part labeled Q44 needs replacing, so what type of part should be ordered?

Answer ______________________________

D. A part is listed by type, but there is no manufacturer's part number given. Can the part be ordered with only that information, and where can the part be ordered from?

Answer ______________________________

E. A customer requests that a cut-rate replacement part be used instead of an OEM part. What should the technician do to protect against the prospects that the cut-rate part might fail soon and recreate a problem?

Answer ______________________________

F. Even though some generic parts and "bargain" parts are of excellent quality, what is the age-old rule about replacement parts?

Answer ______________________________

PARTS AND SUPPLIES
UNIT XI

ASSIGNMENT SHEET #2 — ORDER PARTS FROM A PARTS CATALOG

Directions: *Semiconductor General-Purpose Replacements* is a popular parts catalog published by Howard W. Sams. Using the catalog entails two steps: finding the replacement code number in Part 1 of the catalog, then finding the replacement code in Part 2 and identifying the part by the manufacturer's part number. For convenience, the two-part information is included on the accompanying sheet. Read the information carefully, then answer the following questions:

A. What two manufacturers have the same part number for replacement code 00450?

Answer ______________________________

B. What is the Radio Shack number for replacement code 09408?

Answer ______________________________

C. If Motorola were the OEM and you wanted to use an OEM part for replacement code 09423, what part number would you order?

Answer ______________________________

D. What is the original device type that Workman part number WEP 4089/5920 will replace?

Answer ______________________________

E. Is there any similarity between General Electric part numbers for replacement codes 00450 and 09408, and if so, what is the similarity?

Answer ______________________________

F. What is the Zenith part number for replacement code 00450?

Answer ______________________________

G. What is the Zenith part number for replacement code 09402?

Answer ______________________________

ASSIGNMENT SHEET #2

Part 1 — Original Device Type to Replacement Code Listing

Device Type	Repl Code
1145S	00450
11R6S	09408
11R8S	09415
11R10S	09423
11R45	09402

Part 2 — Replacement Code to General-Purpose Replacement Listing

Repl Code	General Electric Part No.	Motorola Part No.	New-Tone NTE Part No.	Philips ECG Part No.	Radio Shack Part No.	RCA Part No.	Workman Part No.	Zenith Part No.
00450	GE-5040	MR1125	NTE5880	ECG5880		SK3500/ 5882		
09408	GE-5040	MR1126	NTE5882	ECG5882		SK3500/ 5882		212-Z9012
09415	GE-5044	MR1128	NTE5886	ECG5886		SK7090/ 5890		212-Z9013
09423	GE-5044	MR1130	NTE5890	ECG5890		SK7090/ 5890		212-Z9014
09402	GE-5036	MR1124	NTE5878	ECG5878		SK3602/ 5878	WEP 4089/5920	212-Z9011

PARTS AND SUPPLIES
UNIT XI

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

A. A capacitor

B. An integrated circuit

C. A transistor

D. Yes, the part is probably available locally

E. Get the customer to authorize use of the cut-rate part in writing

F. You get what you pay for

Assignment Sheet #2

A. New-Tone and Philips

B. There is none

C. MR1130

D. 11R45

E. The part number is the same for both replacement codes

F. There is none

G. 212-Z9011

PARTS AND SUPPLIES
UNIT XI

JOB SHEET #1 — ROLL IN AND SEAT A DUAL IN-LINE IC

A. Tools and materials

1. Static-free work surface or sheet of aluminum foil
2. Dual in-line integrated circuit as selected by instructor
3. Printed circuit board for IC replacement
4. IC extractor and inserter

B. Procedure

1. Place a sheet of aluminum foil on the work bench and smooth it out
2. Place the IC part onto the foil, but do not touch the pins at this time
3. Touch the foil with both hands
4. Place the printed circuit board into which the IC will be inserted onto the foil and make sure it comes in contact with the foil

   (NOTE: Follow this opening procedure carefully so that everything will be at the same electrical potential before insertion of the IC begins.)

5. Lay the IC part on its side so that it can be readily seen that the pins on each side of the part are spread beyond the normal distance required to insert them into sockets in the printed circuit board
6. Grasp the IC on its open ends and roll it gently from side to side while pressing down with enough force to move one set of pins slightly inward
7. Insert the unbent set of pins on the IC into the printed circuit board sockets where they should go
8. Apply just enough pressure toward the opposite side so that the unbent pins will bend just enough to permit the pins that are already bent to slip into the sockets on the other side
9. Make sure all pins are in their proper sockets, then start seating the IC by rocking it gently end to end, but do not rock it from side to side
10. Continue rocking the IC gently end to end until all pins on both sides of the IC are firmly seated
11. Have your instructor check your work
12. Return tools and equipment to proper storage areas and secure the work station

PARTS AND SUPPLIES
UNIT XI

NAME ________________________

TEST

1. Match the terms on the right with their correct definitions.

   _____a. Any item that is more expensive to repair than a new replacement would cost, or an item that cannot be repaired and must be replaced with a new one

   _____b. A list of components that can be safely interchanged or generic components that can be substituted for OEM components

   _____c. A product that duplicates the performance of a brand name product and is usually lower priced

   _____d. Original equipment manufacturer

   _____e. A problem at inspection stations in airports where X-ray equipment used for examining luggage erases software or causes other problems with computer components

   _____f. Dual in-line package

   1. Generic product
   2. X-ray damage
   3. OEM
   4. Consumable
   5. Cross reference
   6. DIP

2. Complete the following statements concerning how to identify chips by inserting the word(s) that best completes each statement.

   a. Proper identification of chips requires knowing the ____________ used by the manufacturer of the chip

   b. The code marks are ____________ or ____________ that provide:

      1) A ____________ part or device number

      2) Name of the ____________

      3) ____________ of manufacture

      4) The ____________ of the device when the device is a memory part and knowing the ____________ is critical

      5) There are other numbers used for production control data, and significant only to the manufacturer or as an ____________ reference

   c. Most microprocessor and support IC chips have identifying marks printed on their ____________

TEST

3. Complete the following statements concerning how to identify speed on memory chips by inserting the word(s) that best completes each statement.

   a. In many common parts, it is critical to know the access time of the memory as expressed in ____________

   b. It is a general rule that a memory chip may be replaced only with a chip that has an access time ____________ ____________ or less than the original chip

   c. Access time of memory parts may vary from 150 ____________ up to 450 ____________

   d. Use chips of the ____________ ____________ in a bank of memory

4. Select true statements concerning guidelines for inserting chips by placing an "X" in the appropriate blanks.

   _____a. Integrated circuit parts are about the only parts in a computer system that can be inserted, and the procedure is relatively easy, but the preparation requires care

   _____b. Many MOS and CMOS parts can be damaged by static electricity, so unless you know exactly what part you are dealing with, treat it as if it could be damaged by static electricity

   _____c. Work with IC parts on a static-free piece of aluminum foil spread out on the work bench or a manufactured static mat

   _____d. Integrated circuit parts in a dual in-line package require special handling

   _____e. Remember that these dual in-line parts have the pins spread less than the normal distance required for insertion and require special preparation before insertion

   _____f. Pins on dual in-line IC parts should be rolled in with pressure from side to side, and then seated with pressure from end to end

5. Complete the following statements concerning parts listings and parts manuals by inserting the word(s) that best completes each statement.

   a. Parts for microcomputers are usually listed as a section of either a technical or maintenance manual, but may sometimes be listed in a separate ____________ ____________

   b. To use a parts manual or listing properly first requires proper identification of the ____________ ____________

TEST

c. Part numbers on printed circuit boards are frequently silk-screened onto the boards, but when they are not, a ______________ should be used for proper part identification

d. Although there are no real standards for prefix letters that identify parts, some of the common prefixes are:

1) C — ______________

2) Q — ______________

3) R — ______________

4) T — ______________

5) U — ______________

e. Be certain of what the ______________ means, then the part will be easy to find in the parts manual or listing

f. Along with the listing of the manufacturer's part number, there may also be a ______________ part number or a special manufacturer's part number to indicate a part that can be used as a substitute

g. Play it safe when ordering replacement parts by including the ______________ ______________ of the equipment, the part number, and a description of the part

6. Select true statements concerning cross referencing by placing an "X" in the appropriate blanks.

______a. Cross referencing provides a handy guide for common parts such as resistors, capacitors, and common logic IC's that are available locally and do not have to be ordered from a specific manufacturer

______b. Cross references usually appear in user manuals or tech manuals

______c. Many manufacturers supply parts lists cross references to their distributors, and these parts are usually available from a parts supplier

______d. Several specialized parts lists such as those cross reference Japanese and American parts are produced and sold by various publishers

7. Complete the following statements concerning guidelines for handling and shipping static-sensitive parts by inserting the word(s) that best completes each statement.

a. Consider all computer parts and components as ______________ and handle and pack them with care

b. Be especially careful of handling and storing static-sensitive IC's, and never remove the ______________ ______________ ______________ from such parts, even when the parts are going to be stored in a drawer

c. Handle EPROM's with the same care given other IC's, but as an extra precaution, EPROM's should be sealed from ______________ of any kind

TEST

d. IC's, EPROM's, or boards in general that are shipped by air should be packaged for protection against ____________ damage with an X-ray protection bag or a photo protection bag

8. Solve problems concerning guidelines for handling and shipping floppy disk drives and printers by indicating the solutions for the following problems:

a. A technician preparing a floppy disk drive for shipment cannot find a head-protecting cardboard, so what else can be used?

Answer ____

b. A technician preparing a printer for shipment removes all the paper from the printer, so what needs to be done?

Answer ____

9. Complete the following statements concerning special considerations for handling hard disk drives by inserting the word(s) that best completes each statement.

a. Anytime a hard disk containing program information has to be shipped away for repair, use another hard disk, floppy disk, or tape to make a ____________ of the information because the chances are good that the information will be erased in transit

b. Whether in or out of a computer, transporting a hard disk drive requires that the drive head first be properly parked, and this is done by the disk controller with ____________ instructions

c. If the hard disk is an add-on, ship it in the carton with the packing that came with it, and if it's being shipped in the computer, ship the ____________ in its original carton complete with packing

10. Select true statements concerning importance of quality parts and supplies by placing an "X" in the appropriate blanks.

_____a. Microcomputer parts and supplies can be purchased as OEM or generic products

_____b. Generic parts are readily available, usually less expensive than OEM parts, and for certain replacement items such as commonly used resistors and capacitors, are sometimes preferred because they are readily available

_____c. Buying generic parts should be done with caution, and it is not recommended that "bargain" generic parts be purchased from end-of-stock vendors or cut-rate parts houses

_____d. Using a low quality generic part can be costly if it fails and has to be replaced with an OEM part at the store's expense

TEST

_____e. In cases where a customer requests a generic part in order to save money, it is best to do it and ask no questions

_____f. In cases where a customer has substituted or jury-rigged a part and does not want an OEM or quality generic part as a replacement, get the customer's written authorization to retain the substitute or jury-rigged part in the system

_____g. Some generic parts are of excellent quality, and good buyers learn which generic parts to keep in inventory, but in some cases an OEM part is the only thing to use, and in all cases, computer parts are subject to an age-old rule — the most expensive parts are always the best

11. Complete the following statements concerning important points in parts record keeping by inserting the word(s) that best completes each statement.

   a. A record should be kept of any part or component that is traded out for a known good part or component, and that record should contain:

      1) The ____________ ____________ of the malfunctioning part or component

      2) The ____________ ____________ of the known good part or component

      3) The ____________ ____________ of the system into which the known good part is installed

   b. A ____________ ____________ of the problem should also be prepared and signed by the technician who found the problem so that it can be sent along with the bad part to the repair center

   c. For all parts that go back to a repair center, ____________ of the records sent should be kept in the customer file at the store so any questions that may arise at the repair center can be properly referenced at the store

   d. All parts taken from an ____________ should be properly reported so that a bookkeeper or responsible party can keep all inventories up to date

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

12. Solve problems concerning replacement parts. (Assignment Sheet #1)

13. Order parts from a parts catalog. (Assignment Sheet #2)

14. Demonstrate the ability to roll in and seat a dual in-line IC. (Job Sheet #1)

PARTS AND SUPPLIES
UNIT XI

ANSWERS TO TEST

1. a. 4
   b. 5
   c. 1
   d. 3
   e. 2
   f. 6

2. a. Code
   b. Numbers, letters
      1) Basic
      2) Manufacturer
      3) Date
      4) Speed, speed
      5) Engineering
   c. Cases

3. a. Nanoseconds
   b. Equal to
   c. Nanoseconds, nanoseconds
   d. Same speed

4. a,b,c,d,f

5. a. Parts manual
   b. Part number
   c. Schematic
   d. 1) Capacitors
      2) Transistors
      3) Resistors
      4) Transformers
      5) Integrated circuits
   e. Prefix
   f. Generic
   g. Model number

6. a,c,d

7. a. Fragile
   b. Static-proof covering
   c. Light
   d. X-ray

8. a. An old floppy disk
   b. Roll paper into the paper path

ANSWERS TO TEST

9. a. Backup
   b. Software
   c. Computer

10. a,b,c,d,f

11. a. 1) Part number
       2) Part number
       3) Serial number
    b. Brief description
    c. Copies
    d. Inventory

12. Evaluated to the satisfaction of the instructor

13. Evaluated to the satisfaction of the instructor

14. Competency evaluated according to procedures outlined in the job sheet

NOTICE

STAFF MEMBERS AND TECHNICAL ADVISORS HAVE WORKED TO MAKE THESE INSTRUCTIONAL MATERIALS EASY TO USE AND EASY TO READ. WE WELCOME YOUR INPUT IN THE FORM OF SUGGESTIONS AND/OR CORRECTIONS BY RETURNING THE ATTACHED POSTCARD WHICH HAS BEEN PRE-PAID.

THANK YOU.

Name of Publication______________________________

My overall rating of this publication is:

Excellent ☐ Very Good ☐ Good ☐ Fair ☐ Poor ☐

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Other comments ______________________________

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